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LETTER REPORT

**COLORADO DEPARTMENT OF PUBLIC
HEALTH AND ENVIRONMENT
SOURCE AREA DELINEATION AND
RISK-BASED CONSERVATIVE SCREEN
AND
ENVIRONMENTAL PROTECTION AGENCY
AREAS OF CONCERN DELINEATION**

**HUMAN HEALTH RISK ASSESSMENT
WALNUT CREEK PRIORITY DRAINAGE
OPERABLE UNIT NO 6**

FINAL

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

**U S DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado**

ENVIRONMENTAL RESTORATION PROGRAM

October 1994

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LIST OF ACRONYMS

AB	absorption factor
AT	averaging time
AM-241	americium-241
AOC	area of concern
ARAR	applicable or relevant and appropriate requirements
BSL	background screening level
BW	body weight
Cs-137	Cesium-137
CDPHE	Colorado Department of Public Health and Environment
CF	conversion factor
COC	chemical of concern
DOE	U S Department of Energy
ED	exposure duration
EF	exposure frequency
EPA	U S Environmental Protection Agency
FS	feasibility study
HHRA	human health risk assessment
IHSS	individual hazardous substance sites
kg	kilogram
l	liter
MCL	maximum contaminant level
mg	milligram
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi	picocurie
PCOC	potential chemical of concern
Pu-239,240	plutonium-239,240
Ra-226	radium-226
Ra-228	radium-228
RBC	risk-based concentration
RfD	reference dose
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RFP	Rocky Flats Plant
SA	surface area
SF	slope factor
SQL	sample quantitation limit
Sr-89,90	strontium-89,90
SVOC	semivolatile organic compound
TCE	trichloroethene
TOC	total organic carbon
TSS	total suspended solids
U-233,234	uranium-233,234

U-235	uranium-235
U-238	uranium-238
UHSU	upper hydrostratigraphic unit
UTL	upper tolerance limit
VOC	volatile organic compound
WQPL	Water Quality Parameter List

EXECUTIVE SUMMARY

This executive summary provides results of the Colorado Department of Public Health and Environment (CDPHE) Risk-Based Conservative Screen for the Walnut Creek Priority Drainage, Operable Unit No 6 (OU6), at the Rocky Flats Environmental Technology Site (RFETS) in Golden, Colorado. The Walnut Creek Priority Drainage contains 20 Individual Hazardous Substances Sites (IHSSs) where waste materials were formerly stored or deposited. The CDPHE Risk-Based Conservative Screen was developed to support CDPHE's evaluation of contaminant source areas. The screen is used to support the identification of low-hazard areas that may warrant no further evaluation, possible high hazard areas that may warrant potential early action, and those areas which need to be evaluated in the HHRA. The results of the CDPHE conservative screen also provide a guideline as to whether a feasibility study (FS) may be warranted. Finally, the source areas identified in the CDPHE screen will be used to define areas of concern (AOCs) for evaluation in the Human Health Risk Assessment (HHRA) portion of the Phase I RCRA Facility Investigation/Remedial Investigation (RFI/RI) Report for OU6. The RFI/RI is conducted pursuant to the U S Department of Energy (DOE) Environmental Restoration Program, a Compliance Agreement between DOE, the U S Environmental Protection Agency (EPA), and CDPHE, and the Federal Facility Agreement and Consent Order (Interagency Agreement) signed in 1991.

The CDPHE Risk-Based Conservative Screen includes the following six steps:

- Step 1 Define potential chemicals of concern (PCOCs) in soil, pond sediment, stream sediment, pond surface water and groundwater
- Step 2 Identify contaminant source areas based on distribution of PCOCs
- Step 3 Calculate a risk-based concentration (RBC) for each PCOC in soil, pond sediment, stream sediment, pond surface water, and groundwater
- Step 4 Calculate the ratio of the maximum concentration of each PCOC to the corresponding RBC, sum the ratios for each medium and for each source area.

Step 5 Apply CDPHE conservative screen decision criteria to the RBC ratio sums for each source area.

Step 6 Define AOCs for the HHRA based on source areas

In Step 1, PCOCs were identified for soil, pond sediment, stream sediment, pond surface water, and groundwater. PCOCs are defined as (a) metals and radionuclides significantly above background levels as determined by statistical tests (Gilbert 1993) and (b) organic target analytes that were detected above sample quantitation limits (SQLs)

The chief PCOCs in soil were the radionuclides plutonium-239,240 (Pu-239,240), americium-241 (Am-241), the uranium isotopes U-233,234 and U-238, two polycyclic aromatic hydrocarbons (PAHs) (benzo(a)pyrene and benzo(b)fluoranthene), methylene chloride, and numerous metals (some of the metal PCOCs may be naturally occurring even though statistical evaluation identified them as being above background levels). The chief PCOCs in groundwater were chlorinated solvents such as chloroform, methylene chloride, tetrachloroethene, and trichloroethene, nitrate, the radionuclides Am-241, Pu-239,240, and radium-226 (Ra-226), and many metals. Elevated metal concentrations in unfiltered groundwater are probably not due to contamination, but rather due to high total suspended solids resulting from difficulty in sampling wells with low yields, to geochemical characteristics of the groundwater, or other factors. PCOCs in stream sediment, pond sediment, and dry sediment included Am-241 and Pu-239,240, PAHs, and various metals. In addition, Aroclor-1254 and bis(2-ethylhexyl)phthalate were also PCOCs in pond sediment. PCOCs in pond surface water were 1,2-dichloroethene, acetone, chloroform, methylene chloride, trichloroethene, and uranium isotopes.

In Step 2, concentrations of inorganic PCOCs above a background screening level (BSL, the arithmetic mean plus two standard deviations of the background data) and concentrations of organic PCOCs were plotted on maps, and contaminant source areas were identified based on the distribution of PCOCs. Source areas were defined as areas containing concentrations or radioactivities of inorganic PCOCs above the BSL or areas where organic PCOCs were detected above SQLs (CDPHE/EPA/DOE 1994). Eighteen source areas were identified in OU6. The 18 source areas consist of individual IHSSs, with the exception of IHSSs 166 1,

166 2 and 166 3, which are evaluated as one source area. The source areas are listed below
IHSS locations are shown on Figure 1-1

IHSS 141 - Sludge Dispersal Area
IHSS 142 1 - A-1 Pond
IHSS 142 2 - A-2 Pond
IHSS 142 3 - A-3 Pond
IHSS 142 4 - A-4 Pond
IHSS 142 5 - B-1 Pond
IHSS 142 6 - B-2 Pond
IHSS 142 7 - B-3 Pond
IHSS 142 8 - B-4 Pond
IHSS 142 9 - B-5 Pond
IHSS 142 12 - Walnut and Indiana Pond
IHSS 143 - Old Outfall
IHSS 156 2 - Soil Dump Area
IHSS 165 - Triangle Area
IHSSs 166 1, 166 2, and 166 3 - Trenches A, B, and C
IHSS 167 1 - North Area Spray Field
Former IHSS 167 3 - South Area Spray Field
IHSS 216 1 - East Spray Field

OU6 field sampling for the Phase I RFI/RI was performed at the IHSS 167 3 location delineated from an aerial photograph of the landfill area dated October 5, 1993. The location of IHSS 167 3 was moved as a result of the Historical Release Report (DOE 1992), however, the field work was already completed. Since the new location is within the boundaries of OU7, any required new sampling will be performed as part of the OU7 RFI/RI.

In Step 3, RBCs were developed for each PCOC. Chemical-specific RBCs are presented in the Programmatic Risk-Based Preliminary Remediation Goals (DOE 1994a). The RBCs used in this conservative screen were based on a residential scenario for exposure to soil, sediment, pond surface water, and groundwater.

In Step 4, maximum detected concentrations or radioactivities of PCOCs in each medium were compared to RBCs. The following ratio was calculated for each PCOC in each source area

$$\text{Ratio} = \frac{\text{Maximum detected concentration or activity of PCOC}}{\text{RBC for PCOC}}$$

In each source area, PCOC-specific ratios were summed to yield a ratio sum for each medium (soil, pond sediment, pond surface water, or groundwater) that was sampled. Ratio sums above 1 indicate that cumulative effects of PCOCs at maximum detected concentrations exceed a conservative risk-based screening level and that the source area warrants further evaluation.

A summary of the ratio sums by source area is shown in Table ES-1.

In Step 5, the following decision criteria were used to classify the source areas:

- If the ratio sum ≥ 100 , indicating a potential health hazard assuming long-term exposure to maximum detected concentrations, a voluntary corrective action (early action) or a baseline HHRA will be conducted.
- If $1 < \text{ratio sum} < 100$, a baseline HHRA will be conducted.
- If the ratio sum ≤ 1 , indicating a low-hazard source area, no further action may be required, pending evaluation of Applicable or Relevant and Appropriate Requirements (ARARs) and incremental risk from dermal exposure.

Candidates for No Further Action

IHSS 216.1 (East Spray Field) is a candidate for no further action based on negligible soil contamination (ratio sum < 1). Risk from dermal exposure was found to be insignificant. No groundwater is associated with this IHSS.

The IHSSs listed below had negligible soil or sediment contamination (soil or sediment ratio sums were < 1) and risk from dermal exposure was found to be insignificant. Furthermore, the IHSSs are not considered sources of contamination to groundwater because (1) soil or sediment contaminant levels are so low that measurable impacts on groundwater are unlikely, (2) other sources of groundwater contamination are evident or suspected, or (3) maximum concentrations of PCOCs in the groundwater area under evaluation were observed at sampling locations remote from the IHSS. Therefore, these IHSSs are candidates for no further action based on negligible soil or sediment contamination and absence of IHSS-related groundwater contamination. Groundwater is expected to be addressed through other mechanisms, as indicated below.

IHSSs 166 1-3	Trenches	Address groundwater in OU7
Former IHSS 167 3	South Spray Field	Address groundwater in OU7
IHSS 142 4	Pond A-4	Address area 2 (North Walnut Creek drainage) groundwater contamination with the other A-series ponds being evaluated in the baseline HHRA
IHSS 142 9	Pond B-5	Address area 3 (South Walnut Creek Drainage) groundwater contamination with the other B-series ponds being evaluated in the baseline HHRA
IHSS 142 12	Walnut and Indiana Pond	Address potential groundwater contamination at Indiana Street wells in the RFI/RI report

Source Areas for Further Evaluation

The following IHSSs will be evaluated further in the baseline HHRA because the ratio sums for soil or sediment exceeded 1, assuming long-term residential exposure to maximum detected concentrations in soil or sediment at the IHSS. The ratio sums for groundwater also exceeded 1 (and in most cases exceeded 100), but these IHSSs are probably not the source of groundwater contamination. Nevertheless, groundwater exposure will be included in the baseline HHRA. No groundwater is associated with IHSSs 156 2 and 167 1.

IHSS 141	Sludge Dispersal Area
IHSSs 142 1, 142 2, and 142 3	Ponds A-1, A-2, and A-3
IHSSs 142 5, 142 6, 142 7, and 142 8	Ponds B-1 through B-4
IHSS 156 2	Soil Dump Area
IHSS 165	Triangle Area
IHSS 167 1	North Spray Field

Transfer to OU8

IHSS 143, the Old Outfall, is located in the industrialized portion of the plant, remote from other OU6 IHSSs, which are located outside the protected area and in the buffer zone. Because of its location, IHSS 143 is proposed for transfer to OU8, which includes IHSSs in the industrialized area.

In Step 6, AOCs for OU6 were identified for the HHRA. AOCs are defined as one or several source areas that can be grouped based on close proximity. Four AOCs were identified. AOC No. 1 consists only of IHSS 167 1 (North Spray Field) since it is spatially separated from all other source areas that require further evaluation. AOC No. 2 consists of IHSSs 165 (Triangle Area), 141 (Sludge Disposal Area), and 156 2 (Soil Dump Area). These IHSSs are located in close proximity and contain the majority of the contaminated soil within OU6. AOC No. 3 consists of IHSSs 142 1, 142 2, and 142 3 (Ponds A-1, A-2, and A-3) since they are located in close proximity within the same drainage and have the same contaminated media. AOC No. 4 consists of IHSSs 142 5, 142 6, 142 7, and 142 8 (Ponds B-1 through B-4) since they are also located in close proximity within the same drainage and have the same contaminated media.

TABLE ES-1
ROCKY FLATS OU6
SUMMARY TOTAL RATIO SUMS BY SOURCE AREA

Source Areas		Medium	Carcinogenic Ratio Sum ⁽¹⁾	Noncarcinogenic Ratio Sum ⁽¹⁾
IHSS 143	Old Outfall	Soil 0-12'	4 7E+01	1 4E-01
		Groundwater Area 6	1 8E+03	9 4E+01
		Total Ratio Sum	1 8E+03	9 4E+01
IHSS 167 1	North Spray Field	Soil 0-12'	4 9E+00	5 5E-02
		Total Ratio Sum		
Former IHSS 167 3	South Spray Field Area	Soil 0-12'	1 1E-01	3 8E-03
		Groundwater Area 1	2 0E+03	7 4E+01
			2 0E+03	7 4E+01
IHSSs 166 1, 166 2 and 166 3	Trenches A, B, and C	Soil 0-12'	8 3E-01	1 6E-01
		Groundwater Area 1	2 0E+03	7 4E+01
		Total Ratio Sum	2 0E+03	7 4E+01
IHSS 216 1	East Spray Field	Soil 0-12'	3 5E-01	4 4E-02
IHSS 156 2	Soil Dump Area	Soil 0-12'	1 6E+00	4 8E-01
IHSS 141	Sludge Dispersal	Soil 0-12'	3 8E+00	1 0E-01
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 4E+01
IHSS 165	Triangle Area	Soil 0-12'	1 4E+01	1 1E-01
		Groundwater Area 4	1 2E+01	4 8E+00
		Total Ratio Sum	2 6E+01	4 9E+00
IHSS 142 1	A-1 pond	Sediment	2 8E+01	3 2E-02
		Surface water	3 7E-03	2 3E-04
		Groundwater Area 2	1 2E+03	5 3E+01
		Total Ratio Sum	1 2E+03	5 3E+01
IHSS 142 2	A-2 pond	Sediment	1 2E+01	4 4E-02
		Surface water	3 7E-03	2 3E-04
		Groundwater Area 2	1 2E+03	5 3E+01
		Total Ratio Sum	1 2E+03	5 3E+01
IHSS 142 3	A-3 pond	Sediment	3 2E+00	3 5E-02
		Surface water	3 7E-03	2 3E-04
		Groundwater Area 2	1 2E+03	5 3E+01
		Total Ratio Sum	1 2E+03	5 3E+01

TABLE ES-1
(concluded)

Source Areas		Medium	Carcinogenic Ratio Sum ⁽¹⁾	Noncarcinogenic Ratio Sum ⁽¹⁾
IHSS 142 4	A-4 pond	Sediment	1 7E-01	4 1E-01
		Surface water	3 7E-03	2 3E-04
		Groundwater Area 2	1 2E+03	5 3E+01
		Total Ratio Sum	1 2E+03	5 3E+01
IHSS 142 5	B-1 pond	Sediment	3 4E+02	8 0E-01
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 5E+01
IHSS 142 6	B-2 pond	Sediment	1 1E+02	5 0E-01
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 4E+01
IHSS 142 7	B-3 pond	Sediment	1 3E+02	1 0E+00
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 5E+01
IHSS 142 8	B-4 pond	Sediment	3 4E+01	1 4E-01
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 4E+01
IHSS 142 9	B-5 pond	Sediment	2 6E-01	2 5E-03
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 4E+01
IHSS 142 12	Walnut & Indiana Pond	Sediment	3 1E-03	3 4E-05
		Surface Water	-	5 0E-05
		Groundwater	6 5E+02	3 4E+01
		Total Ratio Sum	6 5E+02	3 4E+01
	Stream Sediment	North Walnut	1 4E+00	7 3E-01
		South Walnut	6 9E+00	2 3E-04
		Upgradient	2 8E-10	8 2E-05
		W&I	3 7E-03	3 3E-05
	Dry Sediment	North Walnut	5 3E+00	1 3E-02
		South Walnut	6 9E+00	9 0E-03

⁽¹⁾ For the CDPHE Conservative Screen

Carcinogenic Ratio Sum >1 is equivalent to >10⁻⁶ cancer risk level

Carcinogenic Ratio Sum >100 is equivalent to >10⁻⁴ cancer risk level

Noncarcinogenic Ratio Sum >1 is equivalent to Hazard Index >1

(All assuming long-term residential exposure to maximum detected concentrations of chemicals)

INTRODUCTION

The purpose of this report is to document the results of the Colorado Department of Public Health and Environment (CDPHE) Risk-Based Conservative Screen for Operable Unit No. 6 (OU6) at the Department of Energy (DOE) Rocky Flats Environmental Technology Site (RFETS) in Golden, Colorado. OU6 is comprised of the Walnut Creek Priority Drainage and contains 20 Individual Hazardous Substances Sites (IHSSs) where waste materials were formerly stored, released, or deposited (Figure 1-1). Figure 1-1 shows both the current and historical IHSS boundaries within OU6. The historical IHSS boundaries were used during field sampling for the OU6 Phase I RFI/RI. However, as a result of the publication of the Historical Release Report (DOE 1992), some of the IHSS boundaries were changed either as a result of new information to define the boundaries or error in the previous location of the IHSS. Most of the OU6 IHSS boundaries did not change significantly, however, IHSS 1673 was moved to an entirely different location within the boundaries of OU7. Since the field work had already been completed, evaluation of the new IHSS 1673 will be done as part of the OU7 RFI/RI. Data collected at the former location of IHSS 1673 is evaluated in OU6.

The CDPHE Risk-Based Conservative Screen was used to support CDPHE's evaluation of contaminant source areas and the identification of (1) low hazard areas that may warrant no further evaluation, (2) possible high hazard areas that may warrant early action, and (3) areas that need to be evaluated in the baseline human health risk assessment (HHRA) portion of the Phase I RCRA Facility Investigation/Remedial Investigation (RFI/RI) report for OU6. The CDPHE screen also provides a decision point as to whether a feasibility study (FS) is warranted for the source area. This report also includes the identification of areas of concern (AOCs) that will be evaluated in the baseline HHRA. An AOC may be comprised of one or more source areas that can be grouped based on close proximity. In the RFI/RI report, a baseline HHRA will be conducted for each AOC.

Guidance for data aggregation for risk assessment and for the risk-based conservative screen was provided in documents prepared jointly by CDPHE, U.S. Environmental Protection Agency (EPA), and DOE (CDPHE/EPA/DOE 1994). The risk-based screen divides the maximum detected concentrations of potential contaminants in each source area by risk-based

concentrations (RBCs) for chemicals in soil, sediment, pond surface water, or groundwater. The resulting chemical-specific ratios are then summed. If the sum of the ratios is less than 1, the source area is a candidate for no further action. If the ratio sum exceeds 1, the source area is subject to further evaluation, either in a baseline HHRA or as a candidate for early action. Therefore, the CDPHE Risk-Based Conservative Screen can be used to identify no further action source areas, potential early action source areas, and source areas that can be combined into AOCs for evaluation in the baseline HHRA.

The CDPHE Risk-Based Conservative Screen does not replace the selection of chemicals of concern, exposure pathway analysis, exposure assessment, toxicity assessment, risk characterization, and uncertainties analysis that are required in an HHRA and are used to support risk management decisions. The relationship of the HHRA to the CDPHE screen is illustrated in Figure 1-2.

The process used to conduct the CDPHE Risk-Based Conservative Screen is illustrated in Figure 1-3. The steps in the screen are listed below:

Step 1 - Define Potential Chemicals of Concern (PCOCs). PCOCs are defined as (a) metals and radionuclides significantly above background levels, and (b) organic target analytes detected above sample quantitation limits (SQLs) in soil, sediment, surface water, or groundwater samples in OU6. The background determination was made on the basis of statistical comparison of OU6 data to background data (Gilbert 1993).

Step 2 - Identify Source Areas. Contaminant source areas are defined as areas containing organic PCOCs above SQLs or inorganic PCOCs at concentrations or radioactivities above the arithmetic mean plus two standard deviations of the background data.

Step 3 - Calculate Risk-Based Concentrations. RBCs were calculated for each PCOC. RBCs are health-protective chemical concentrations in soil, sediment, surface water, and groundwater. They are calculated using conservative assumptions regarding residential exposure, chemical toxicity, and target risk levels. The RBCs

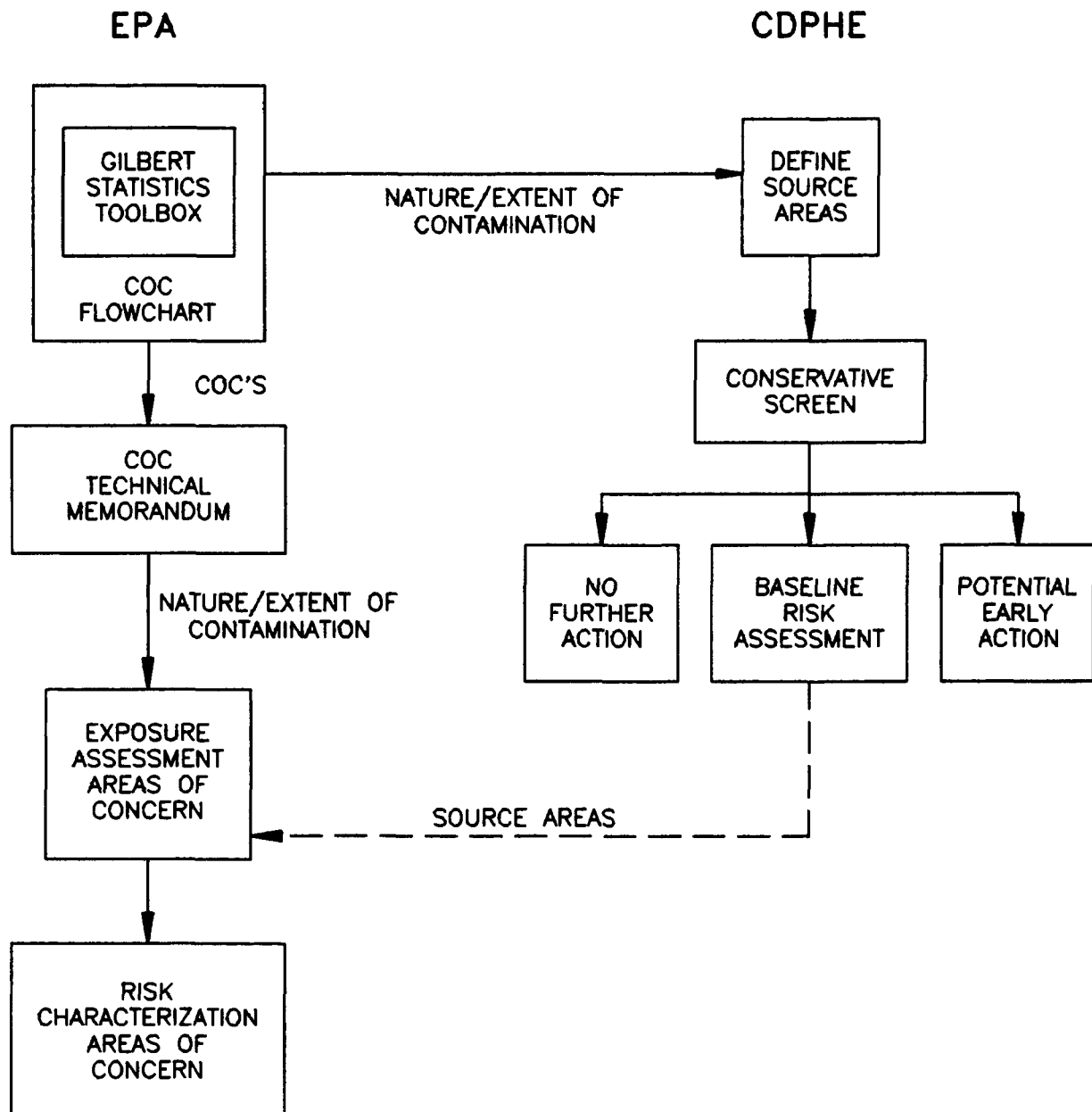
used in the CDPHE Risk-Based Screen are presented in the Final Rocky Flats Programmatic Risk-Based Preliminary Remediation Goals (DOE 1994a)

Step 4 - Calculate RBC Ratio Sums for Each Source Area. The ratio of the maximum detected concentration or (radioactivity) to the corresponding RBC is calculated for each organic PCOC and for each inorganic PCOC that occurs in the source area at a concentration or radioactivity above the background mean plus two standard deviations. Maximum detected concentrations or radioactivities in soil are identified from samples collected to a depth of 12 feet, which is the depth recommended for use by CDPHE. The chemical-specific and radionuclide-specific ratios are then summed for each medium, resulting in a ratio sum for the medium (soil, sediment, surface water, and groundwater). Ratio sums for each medium present in the source area are also added to yield a total ratio sum for the source area. If any ratio or ratio sum exceeds 1, the source area warrants further evaluation.

Step 5 - Apply CDPHE Risk-Based Conservative Screen Decision Criteria. The ratio sums determined in Step 4 are used to designate source areas as candidates for no further action, as candidates for further evaluation in the HHRA, or as candidates for possible early action. For source areas with ratio sums less than 1, DOE may pursue a no further action alternative. Source areas with ratio sums between 1 and 100 will be evaluated in the baseline HHRA. For source areas with ratio sums above 100, DOE may pursue a voluntary early action alternative or evaluate the source area further in the baseline HHRA.

Step 6 - Define AOCs for the HHRA. As stated earlier, an AOC is a source area or group of source areas in close proximity. A baseline HHRA will be conducted for each AOC. AOC delineation is reviewed and approved by EPA. The baseline HHRA will assess exposure to chemicals of concern (COCs) (a subset of PCOCs) that are identified following EPA and CDPHE-approved procedures. The selection of COCs for the HHRA is presented in Technical Memorandum No. 4, Chemicals of Concern for OU6 (DOE 1994b).

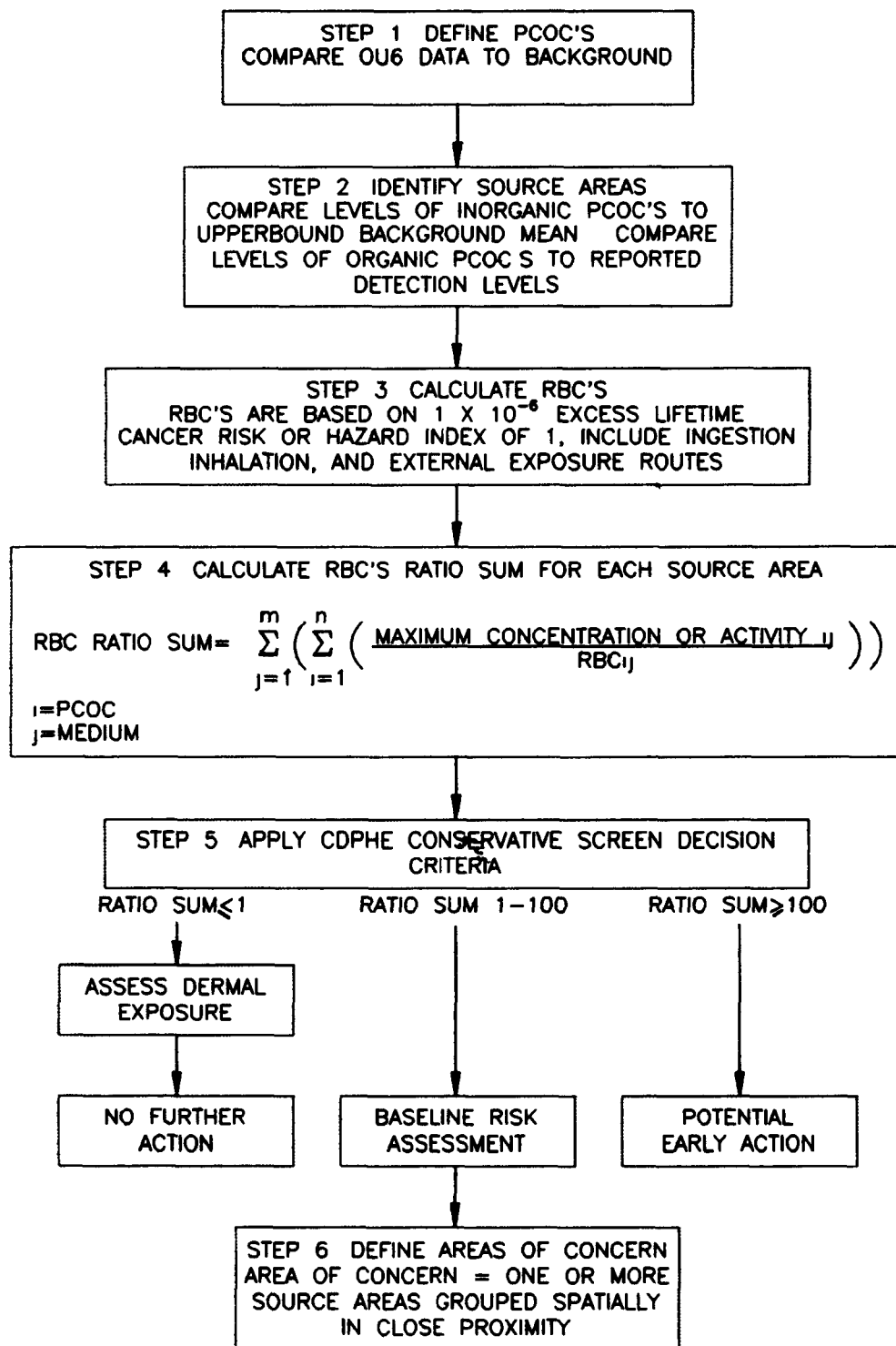
The following sections of this report describe the application and results of each step of the CDPHE screen.



U S DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO 6
CDPHE CONSERVATIVE SCREEN

AREA OF CONCERN
IDENTIFICATION PROCESS



CDPHE = COLORADO DEPARTMENT OF PUBLIC HEALTH
AND ENVIRONMENT

PCOC = POTENTIAL CHEMICAL OF CONCERN

RBC = RISK-BASED CONCENTRATION

U S DEPARTMENT OF ENERGY
Rocky Flats Environmental Technology Site
Golden, Colorado

OPERABLE UNIT NO 6
CDPHE CONSERVATIVE SCREEN

CDPHE CONSERVATIVE SCREEN PROCESS

IDENTIFICATION OF POTENTIAL CHEMICALS OF CONCERN

Step 1 of the CDPHE Risk-Based Screen is to identify PCOCs for OU6. PCOCs are defined as (a) metals and radionuclides significantly above background levels and (b) organic target analytes detected above SQLs in surface soil, subsurface soil, or groundwater samples in OU6. The background determination was made on the basis of statistical comparison of OU6 data to background data (Gilbert 1993). The data sets used in the evaluation, the background comparison process, and the identification of PCOCs for OU6 are summarized in this section. Greater detail is provided in the Technical Memorandum No. 4, Chemicals of Concern, for OU6 (DOE 1994b).

2.1 DATA USED FOR EVALUATION

Chemical analytical data from environmental samples collected during the OU6 field sampling program and Rocky Flats site-wide sampling programs were evaluated to characterize contamination in OU6. The data sets used for evaluation of surface soil, subsurface soil, sediments, surface water, and groundwater are described below.

2.1.1 Surface Soil

Surface soil samples were collected using the Rocky Flats Plant (RFP) soil sampling method, a composite method in which the top 2 inches of soil are collected. Samples were collected from the third quarter of 1992 through the first quarter of 1993. The analytical parameters varied among IHSSs, as described below.

IHSS 141 (Sludge Dispersal Area) - Forty surface soil samples were collected. Samples were analyzed for pesticides/polychlorinated biphenyls (PCBs), metals, nitrate, and radionuclides.

IHSS 143 (Old Outfall) - Four surface soil samples were collected. Samples were analyzed for semivolatile organic compound (SVOCs), pesticides/PCBs, metals, nitrate, total organic carbon (TOC), and radionuclides.

IHSS 156.2 (Soil Dump Area) - Twenty-two surface soil samples were collected and analyzed for metals, radionuclides, and TOC

IHSS 165 (Triangle Area) - Fifteen surface soil samples were collected and analyzed for metals, radionuclides, and TOC

IHSS 167.1 and former IHSS 167.3 (North and South Spray Fields) - Thirty-two surface soil samples were collected in IHSS 167 1, and eight samples were collected in an area formerly identified as IHSS 167 3 near the South Spray Fields. Samples were analyzed for metals, radionuclides, and TOC

IHSS 216.1 (East Spray Field) - Six surface soil samples were collected and analyzed for metals, radionuclides, and TOC

2.1.2 Subsurface Soil

Subsurface soil samples were collected from the fourth quarter of 1992 through the first quarter of 1993. Subsurface soil analytical parameters and depth intervals varied among IHSSs, as described below

IHSS 143 (Old Outfall) - Thirty-one soil borings were drilled 2 feet into undisturbed soil beneath the fill. Samples were taken continuously and composited for each 6-foot interval. Samples were analyzed for volatile organic compounds (VOCs), SVOCs, pesticide/PCBs, metals, TOC, nitrate, and radionuclides. The thickness of the fill varies from 0 to 10 feet

IHSS 156.2 (Soil Dump Area) - Twenty-two soil borings were drilled 3 feet into the undisturbed soil beneath the fill. Samples were taken continuously in these soil borings and composited for each 6-foot interval. Samples were analyzed for VOCs, metals, and radionuclides. The thickness of the fill is approximately 7½ feet across the site

IHSS 165 (Triangle Area) - Nine soil borings were drilled 3 feet into weathered bedrock. Two monitoring wells (76192 and 76292) were drilled to depths of 20 and 22½ feet, respectively. Six-foot-deep composite samples were collected from the soil borings prior to

the development of monitoring wells. Samples were analyzed for VOCs, SVOCs, metals, and radionuclides.

IHSSs 166.1-3 (Trenches A, B, C) - Twenty-six borings were drilled to 5 feet below the bottom of each trench. Eight borings were drilled in Trench A, seven borings in Trench B, six borings in the western part of Trench C, and five borings in the eastern part of Trench C. Samples were analyzed for VOCs, metals, and radionuclides.

IHSS 167.1 and former IHSS 167.3 (North and South Spray Fields) - Twenty-three borings were drilled in the North Spray Field. Nine soil borings were also drilled in an area formerly identified as IHSS 167.3 (South Spray Field). The soil borings were sampled in 2-foot intervals to a depth of 4 feet. Samples were analyzed for metals, radionuclides, and TOC.

IHSS 216.1 (East Spray Field Area) - Six soil borings were drilled to a depth of 4 feet. The soil borings were sampled in 2-foot intervals. Samples were analyzed for metals, radionuclides, and TOC.

2.1.3 Groundwater

Groundwater samples were collected from onsite monitoring wells on a quarterly basis under a plant-wide groundwater sampling program. The plant-wide monitoring program included two monitoring wells installed during the OU6 Phase I investigation and wells installed during other investigations conducted from 1991 through 1993.

Samples used for evaluation of OU6 groundwater contaminant concentrations were collected from the first quarter of 1991 through the fourth quarter of 1993. The number of groundwater samples collected by analyte group were: 279 samples for VOC analysis, 14 samples for SVOC analysis, 11 samples for pesticides/PCBs analysis, 191 filtered samples for metals analysis, 107 unfiltered samples for metals analysis, 172 filtered samples for radionuclides analysis, 138 unfiltered samples for radionuclides analysis, and 279 samples for analysis for the water quality parameter list (WQPLs).

2.1.4 Stream Sediments

Fifteen sediment samples from the stream channels of North and South Walnut Creeks were collected in May 1993 during the OU6 Phase I investigation. Two-foot composite samples were collected using a 2-inch-diameter core sampler with a hand driver. The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, radionuclides, and WQPLs.

2.1.5 Dry Sediments

Eighteen dry sediment samples were collected in the floodplains of the A and B-series ponds in February 1993. The samples were collected using the RFP soil sampling method. The samples were analyzed for SVOCs, pesticides/PCBs, metals, radionuclides, and WQPLs.

2.1.6 Pond Sediments

Pond sediment samples were collected during the fourth quarter of 1992 as part of the site-wide surface water sampling program. Each of the ponds was sampled at five locations. One of the samples was collected within 5 feet of the inlet to each pond. The second sample was collected from the deepest part of each pond. The other three samples were collected at random locations within each pond. Composite samples were collected from 2-foot intervals. If the sediment depth was greater than 2 feet, an additional sample was collected from 2 to 4 feet. A total of seven samples were collected from the 2 to 4-foot interval.

Fifty-seven pond sediment samples are included in the data set. Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, radionuclides, and WQPLs.

2.1.7 Pond Surface Water

Pond surface water samples were collected in the third and fourth quarters of 1992 as part of the site-wide surface water sampling program. Five surface water samples were collected from each of the four A-series ponds, from each of the five B-series ponds, and from the Walnut and Indiana Pond. One of the five samples was collected from the deepest part of each pond. A second sample was collected within 5 feet of the inlet to each pond. The third sample was collected within 5 feet of each spillway. The two remaining samples were

collected randomly in each pond. Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals (filtered and unfiltered samples), radionuclides (filtered and unfiltered samples), and WQPLs.

2.2 BACKGROUND COMPARISON FOR INORGANIC CONSTITUENTS

Analytical results for metals and radionuclides were compared to background levels derived from data for subsurface soil, seep/springs, streambeds, and groundwater reported in the Background Geochemical Characterization Report (DOE 1993) and from 18 background surface soil samples collected in the Rock Creek area during the 1991 OU1 Phase III investigation and the 1993 OU2 Phase II investigation. Metals and radionuclides whose concentrations did not significantly exceed background levels were eliminated from further consideration as PCOCs. Calcium, iron, magnesium, silicon, and sodium were also eliminated from the further evaluation in the risk-based screens because they are essential nutrients or commonplace rock-forming elements and are not considered a health risk.

The methods used to evaluate whether a metal or radionuclide exceeded background levels are summarized below. Attachment 1 presents summary tables of statistical results of the background comparison for metals and radionuclides in all media. Technical Memorandum No. 4, Chemicals of Concern for OU6 (DOE 1994b), presents the background comparison methodology and results in more detail.

- **Statistical tests.** Analytical results for metals and radionuclides were compared to the background data using four statistical tests: the Quantile test, Slippage test, Student's t-test, and the Gehan test (Gilbert 1993). Test conditions and treatment of non-detect values are discussed in Technical Memorandum No. 4 (DOE 1994b, Appendix A). The analyte was considered to be significantly above background if it failed any test at the $p \leq 0.05$ level.
- **UTL_{99/99} comparison.** Analytical results for each metal and radionuclide were compared to the 99 percent upper tolerance limit of background data calculated at the 99 percent confidence level (UTL_{99/99}). The UTL_{99/99} test is an indicator of possible hot spots (Gilbert 1993), however, with large sample sizes of one hundred to three hundred, it is to be expected that a few OU6 data points

would exceed the UTL_{99/99} value. Nevertheless, if any result exceeded the UTL_{99/99}, the analyte was identified as a PCOC subject to spatial and temporal evaluation, and assessment of the lognormal UTL.

- **Lognormal UTL_{99/99} comparison** The background UTLs_{99/99} presented in the Background Geochemical Characterization Report (DOE 1993) were calculated assuming that the background data were normally distributed. This assumption may not be appropriate for all analytes. Concentrations of some analytes were within background range according to all statistical tests performed, but one or two results exceeded the background UTL_{99/99} and, therefore, the analyte was identified as a PCOC. When the distribution of the background data was tested, if a log-normal distribution was a better fit, the UTL_{99/99} was recalculated based on lognormal distribution and the OU6 results were compared to the lognormal-based UTL_{99/99}. This statistical reevaluation resulted in excluding some analytes as PCOCs (these analytes are noted on tables in Attachment 1).

2.2.1 Surface Soil Background Comparison

Table 2-1 lists the maximum detected concentrations/activities and detection frequencies for metals and radionuclides that were identified as PCOCs in surface soil, based on the statistical background comparison. Background surface soil data consist of analytical results from samples collected at 18 locations in the Rock Creek area. The results of the statistical comparisons to background data are summarized in Attachment 1.

Antimony, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, silver, strontium, vanadium, and zinc were identified as PCOCs in surface soil, based on the background comparison. The maximum lead concentration was 68.7 milligrams per kilogram (mg/kg), which is below the EPA screening level of 400 mg/kg for residential soil (EPA 1994).

Plutonium-239,240 (Pu-239,240) and americium-241 (Am-241) were the only radionuclide PCOCs identified in surface soil.

2.2.2 Subsurface Soil Background Comparison

Table 2-2 lists the maximum detected concentrations/activities and the detection frequencies for metals and radionuclides identified as PCOCs in subsurface soil, based on the statistical background comparison. Background data for subsurface soils were taken from the Background Geochemical Characterization Report (DOE 1993). The results of the statistical comparisons of OU6 inorganic data to background data are summarized in Attachment 1.

Barium, chromium, lead, strontium, vanadium, and zinc were identified as PCOCs in subsurface soil, based on the background comparison. The maximum lead concentration of 85 mg/kg was well below EPA's screening level of 400 mg/kg for residential soil (EPA 1994).

Pu-239,240, Am-241, and the uranium isotopes, U-233,234, U-238, and U-235 were also identified as PCOCs in subsurface soil.

2.2.3 Groundwater Background Comparison

Table 2-3 lists the maximum detected concentrations/activities and detection frequencies of metals and radionuclides identified as PCOCs in upper hydrostratigraphic unit (UHSU) groundwater, based on the statistical background comparison of unfiltered samples.

Background data for UHSU groundwater were taken from the Background Geochemical Characterization Report (DOE 1993). The results of the statistical background comparisons for inorganics are summarized in Attachment 1. Inspection of the Attachment 1 tables for metals in unfiltered groundwater samples reveals that nearly all metals (including typical rock-forming elements such as aluminum, calcium, iron, and sodium) were identified as being above background levels. These and other metals in groundwater are probably naturally occurring, with elevated concentrations due to local geochemical characteristics or high total suspended solids in unfiltered samples collected from wells with low yields. Nevertheless, they were retained for evaluation in the CDPHE Risk-Based Screen.

Nitrate is also considered to be a PCOC in groundwater because its maximum concentration of 1,760 milligrams per liter (mg/l) is well above the background screening level (background mean plus two standard deviations) of 33 mg/l

Am-241, cesium-137 (Cs-137), Pu-239,240, radium-226 (Ra-226), and strontium-89,90 (Sr-89,90) were detected at concentrations exceeding background in groundwater

2.2.4 Stream Sediment Background Comparison

Table 2-4 lists the maximum detected concentrations/activities, and detection frequencies for metals and radionuclides identified as PCOCs in stream sediments, based on the background comparison. Stream sediments were compared to background data from streambeds reported in the Background Geochemical Characterization Report (DOE 1993). The results of the statistical comparison of OU6 stream sediment data to background data are summarized in Attachment 1.

Arsenic, barium, cobalt, manganese, strontium, vanadium, and zinc were identified as PCOCs in stream sediments, based on the statistical background comparison. Only analytes with maximum concentrations exceeding the background mean plus two standard deviations appear on the tables in Section 5.0.

Am-241 and Pu-239,240 are the only radionuclides that were also identified as PCOCs in stream sediment.

2.2.5 Dry Sediment

Dry sediments are located within the floodplain of each pond but above the normal water level; they are saturated only during large storms or flooding. A statistical comparison to background data was not performed for these data. Instead, inorganic PCOCs in dry sediment were defined as metals or radionuclides with concentrations exceeding a background screening level (BSL) (the arithmetic mean plus two standard deviations of background data from surface soil). PCOCs were identified separately for the A-series ponds (North Walnut Creek Drainage) and the B-series ponds (South Walnut Creek Drainage).

Maximum concentrations/activities of metals and radionuclides identified as PCOCs in dry sediment are listed in Table 2-5. Metal PCOCs include copper, mercury, nickel, strontium, and zinc in the North Walnut Creek drainage, and nickel, strontium, and zinc in the South Walnut Creek drainage. Am-241 and Pu-239,240 are PCOCs in dry sediments in both drainages.

Surface soil was selected for the background screening rather than stream or seep data because the dry sediment and surface soil are normally dry, and because samples from both media were collected from the top 2 inches of soil, rather than a 2-foot composite, as was done for pond and stream sediments. However, inspection of the background screening levels shown for surface soil and stream sediment in Table 2-5 suggest that the dry sediment composition is closer to stream sediment than surface soil.

2.2.6 Pond Sediment

Table 2-6 lists the maximum detected concentrations/activities and detection frequencies of metals and radionuclides identified as PCOCs in pond sediment. Background sediment data from seeps/springs reported in the Background Geochemical Characterization Report (DOE 1993) were used for comparison to pond sediment data. Seep/springs data were selected rather than background stream sediment data for this comparison because of the similar flow regime (long residence time) in the seeps and ponds.

Antimony, chromium, cobalt, copper, manganese, silver, vanadium, and zinc were identified as PCOC metals in pond sediment. Am-241, Pu-239,240, Ra-226, Ra-228, Sr-89,90, and the uranium isotopes U-233,234, U-235, and U-238 were identified as radionuclide PCOCs in pond sediment.

2.2.7 Pond Surface Water

As shown in Attachment 1, only U-233,234, U-235, and U-238 were identified as inorganic PCOCs in pond surface water, based on statistical comparison to background data from seeps/springs. These isotopes are thought to be naturally occurring (see discussion in Technical Memorandum No. 4, Chemicals of Concern, DOE 1994b). However, they are retained as PCOCs for evaluation in the CDPHE conservative screen.

2.3 SUMMARY OF PCOCs

Tables 2-2 through 2-6 list the inorganic PCOCs in surface soil, subsurface soil, UHSU groundwater, stream sediments, and pond sediments, including maximum detected concentrations/activities and detection frequencies. Organic contaminants detected in each medium are considered PCOCs and are included in the risk-based screen tables accompanying Section 5.0.

The chief PCOCs in each medium, based on potential contribution to overall risk, are identified below. The list does not show all of the PCOCs in each medium but rather those PCOCs that have the largest contribution to risk or are most ubiquitous throughout OU6.

Summary of Chief PCOCs by Medium

Medium	Organic Compounds	Metals*	Radionuclides
Surface Soil		Antimony Chromium Nickel Silver Strontium Vanadium Zinc	Pu-239,240 Am-241
Subsurface Soil	Benzo(a)pyrene Benzo(b)fluoranthene Methylene chloride	Barium Chromium Strontium Vanadium	Pu-239,240 Am-241 U-233,234 U-238

Summary of Chief PCOCs by Medium (cont'd)

Medium	Organic Compounds	Metals*	Radionuclides
Groundwater	Chloroform	Nitrate	Pu-239,240
	Methylene chloride	Antimony	Am-241
	Tetrachloroethene	Arsenic	Ra-226
	Trichloroethene	Barium	
		Beryllium	
		Cadmium	
		Manganese	
		Molybdenum	
		Nickel	
		Selenium	
		Silver	
		Strontium	
		Vanadium	
Stream Sediment	Polycyclic aromatic hydrocarbons	Arsenic	Am-241
		Barium	Pu-239,240
		Manganese	
		Strontium	
		Vanadium	
Dry Sediment	Polycyclic aromatic hydrocarbons	Mercury	Am-241
		Nickel	Pu-239,240
		Strontium	
		Zinc	
Pond Sediment	Aroclor-1254	Antimony	Am-241
	Polycyclic aromatic hydrocarbons	Chromium	Pu-239,240
	Bis(2-ethylhexyl)phthalate	Manganese	
		Silver	
		Vanadium	
Pond Surface Water	1,2-Dichloroethene		U-233,234
	Acetone		U-235
	Chloroform		U-238
	Methylene chloride		
	Trichloroethene		

* Metals in groundwater are probably naturally occurring

TABLE 2-1
ROCKY FLATS OU6
POTENTIAL CHEMICALS OF CONCERN
METALS AND RADIONUCLIDES
SURFACE SOIL

Chemical	Maximum Detected Concentration	Detection Frequency %
Metals (mg/kg):		
Antimony	43 6	47
Chromium	35 1	99
Cobalt	20 3	100
Copper	61 6	100
Lead	68 7	100
Mercury	0 34	41
Molybdenum	9 9	1
Nickel	22 5	95
Silver	52 7	8
Strontium	255	100
Vanadium	75 9	100
Zinc	650	100
Radionuclides (pCi/g):		
Americium-241	3 243	100
Plutonium-239,240	15 22	100

TABLE 2-2
ROCKY FLATS OU6
POTENTIAL CHEMICALS OF CONCERN
METALS AND RADIONUCLIDES
SUBSURFACE SOIL

Chemical	Maximum Detected Concentration	Detection Frequency %
Metals (mg/kg):		
Barium	2970	100
Chromium	217	98
Lead	84.9	100
Strontium	506	100
Vanadium	118	100
Zinc	706	100
Radionuclides (pCi/g):		
Americium-241	0.44	100
Plutonium-239,240	0.88	100
Uranium-233,234	3.05	100
Uranium-235	0.16	100
Uranium-238	141	100

TABLE 2-3
ROCKY FLATS OU6
POTENTIAL CHEMICALS OF CONCERN
METALS AND RADIONUCLIDES
UHSU GROUNDWATER

Chemical	Maximum Detected Concentration	Detection Frequency %
Metals and Other Inorganics (mg/l):		
Aluminum	456	95
Antimony	0.194	16
Arsenic	0.018	52
Barium	5.06	98
Beryllium	0.032	30
Cadmium	0.0329	26
Chromium	0.58	75
Cobalt	0.228	45
Copper	6.43	54
Lead	0.254	73
Lithium	0.456	93
Manganese	6.2	94
Mercury	0.0015	10
Nickel	1.07	66
Selenium	0.475	58
Silver	3.04	20
Strontium	6.96	100
Vanadium	0.754	74
Zinc	8	83
Nitrate	1760	89
Radionuclides (pCi/l):		
Americium-241	3.2	100
Cesium-137	3.65	100
Plutonium-239,240	8.8	100
Radium-226	4.5	100
Strontium-89,90	1.22	100

TABLE 2-4
ROCKY FLATS OU6
POTENTIAL CHEMICALS OF CONCERN
METALS AND RADIONUCLIDES
STREAM SEDIMENT

Chemical	Maximum Detected Concentration	Detection Frequency %
Metals (mg/kg):		
Arsenic	5 8	93
Barium	177	100
Cobalt	12 4	100
Manganese	1000	100
Strontium	95 8	100
Vanadium	33 9	100
Zinc	178	100
Radionuclides (pCi/g):		
Americium-241	0 75	100
Plutonium-239,240	1 95	100

TABLE 2-5
ROCKY FLATS OU6
POTENTIAL CHEMICALS OF CONCERN
METALS AND RADIONUCLIDES
DRY SEDIMENT

Analyte	Maximum Detected Concentration		Background Mean + 2 Std Dev ⁽¹⁾	
	N Walnut Cr (A-series ponds)	S Walnut Cr (B-series ponds)	Surface Soil	Stream Sediment
Metals (mg/kg):				
Copper	22.8	<	20.2	27.4
Mercury	0.18	<	0.13	0.3
Nickel	25.2	26.4	19.7	18.7
Strontium	69.7	92.4	63	210
Zinc	293	286	71.4	220
Radionuclides (pCi/g):				
Americium-241	0.44	1.29	0.04	1.14
Plutonium-239,240	4.44	3.1	0.09	3.76

< Maximum concentration was below the background screening level in surface soil

⁽¹⁾ From data reported in 1993 Background Geochemical Characterization Report (DOE 1993)

TABLE 2-6
ROCKY FLATS OU6
POTENTIAL CHEMICALS OF CONCERN
METALS AND RADIONUCLIDES
POND SEDIMENT

Chemical	Maximum Detected Concentration	Detection Frequency %
Metals (mg/kg):		
Antimony	68 5	39
Chromium	96 1	100
Cobalt	15 5	100
Copper	125	100
Manganese	558	100
Silver	345	39
Vanadium	62 7	100
Zinc	1270	100
Radionuclides (pCi/g):		
Americium-241	230 53	100
Plutonium-239,240	1174	100
Radium-226	1 25	100
Radium-228	2 3	100
Strontium-89,90	1 8	100
Uranium-233,234	15 935	100
Uranium-235	0 854	100
Uranium-238	26 445	100

DELINEATION OF CONTAMINANT SOURCE AREAS

A source area is defined as an IHSS or group of IHSSs where concentrations or activities of PCOCs in soil or groundwater exceed an upper-bound estimate of the background range (CDPHE/EPA/DOE 1994). The upper-bound estimate of the background range for metals and radionuclides is defined as the background mean plus two standard deviations, detected organic compounds are considered to be above background levels.

The IHSSs within OU6 are both physically separated and are defined by different types and sources of contamination. Therefore, with the exception of IHSSs 166 1, 166 2, and 166 3 (Trenches A, B, and C), which were evaluated in the CDPHE screen as a single source area, all other IHSSs were evaluated as individual source areas.

Surface soil, subsurface soil, pond surface water, and pond sediments were sampled on an IHSS-specific basis, and these data were sorted by IHSS for each source area evaluation.

No groundwater contaminant plumes have been identified with sources in OU6, however, some groundwater contamination is evident within the OU6 area, probably related to sources upgradient of OU6, such as the Solar Ponds (OU4), the landfill (OU7), and the Mound Area (OU2). Groundwater was not sampled on an IHSS-specific basis. Therefore, the groundwater sampling locations were divided into six areas, corresponding primarily with drainages (Figure 3-1). For purposes of conducting the CDPHE conservative screen, which evaluates multiple media at each source area, the OU6 IHSSs were assigned to one of the groundwater areas based on close proximity or co-location with the groundwater sampling locations. The groundwater areas and the IHSSs evaluated within that groundwater area are shown below.

Ground-water Area	Drainage	Co-located IHSSs
1	Unnamed Tributary	166 1,2,3 and former 167 3
2	North Walnut Creek	Ponds A-1 - A-4
3	South Walnut Creek	141 and Ponds B-1 - B-5
4	Upgradient (between N and S Walnut Cr)	165
5	Walnut and Indiana (not shown on Fig 3-1)	142 12 (W&I Pond)
6	Old Outfall	143

Some IHSSs have no UHSU groundwater associated with them and, therefore, groundwater is not evaluated in the CDPHE screen for these source areas. These are IHSS 167 1 (North Spray Field), IHSS 216 1 (East Spray Field), and IHSS 156 2 (Soil Dump Area).

Stream sediment and dry sediment samples were not assigned to any source area in OU6. Instead, the CDPHE conservative screen was performed for each of these media separately. Relative risk from exposure to multiple media (e.g., exposed sediments and groundwater) was evaluated for each of the pond IHSSs using pond sediment data and the designated groundwater area data. This is a reasonable but conservative (protective) approach because the pond sediments are more contaminated than the stream or dry sediments and, therefore, the CDPHE screen for pond source areas was conducted using maximum sediment concentrations.

In conclusion, the source areas in OU6 and the media evaluated in each source area are

- IHSS 143 (Old Outfall) - soil and groundwater (area 6)
- IHSS 167 1 (North Spray Field) - soil
- Former IHSS 167 3 (South Spray Field Area) - soil and groundwater (area 1)
- IHSSs 166 1, 166 2, and 166 3 (Trenches A, B, and C) - soil and groundwater (area 1)

- **IHSS 216 1 (East Spray Field) - soil**
- **IHSS 156 2 (Soil Dump Area) - soil**
- **IHSS 141 (Sludge Dispersal Area) - soil and groundwater (area 3)**
- **IHSS 165 (Triangle Area) - soil and groundwater (area 4)**
- **IHSSs 142 1-4 (Ponds A-1 through A-4) - surface water, pond sediment, and groundwater (area 2)**
- **IHSSs 142 5-9 (Ponds B-1 through B-5) - surface water, pond sediment, and groundwater (area 3)**
- **IHSS 142 12 (Walnut and Indiana Pond) - surface water, pond sediment, and groundwater (area 5)**

CALCULATION OF RISK-BASED CONCENTRATIONS

RBCs are chemical concentrations in soil, sediment, surface water, and groundwater that are not expected to pose a health risk even under long-term exposure. They are calculated using conservative assumptions regarding toxicity, long-term residential exposures, and acceptable risk. The purpose of developing chemical-specific RBCs and comparing them to concentrations of PCOCs at each source area is (1) to provide preliminary screening-level information on the relative magnitude of chemical contamination at source areas and (2) to identify those PCOCs that may pose a human health risk, assuming long-term exposure to maximum detected concentrations. This information can be used in the preliminary selection of remedial alternatives prior to the completion of the HHRA and can also identify source areas where no further action may be needed. The screening-level information based on RBCs is not used as a substitute for a complete HHRA or as a stand-alone decision-making tool, nor are RBCs used as site-specific cleanup levels.

For this risk-based screen, RBCs were calculated assuming long-term residential exposure to soil, sediment, surface water, and groundwater. At the direction of CDPHE, sediments were assumed to be exposed and equivalent to soil for purposes of this screen. RBCs for residential exposure to soil and sediment are calculated assuming ingestion, inhalation of particulates, and external radiation pathways. RBCs for surface water are calculated assuming a residential swimming scenario and include incidental ingestion and external radiation pathways. RBCs for groundwater are calculated assuming ingestion as drinking water and inhalation of VOCs released during domestic use. Separate RBCs are calculated for carcinogenic and noncarcinogenic effects of chemicals and radiation effects of radionuclides. RBCs for chemical carcinogens and radionuclides are calculated based on a 1 in 1,000,000 (10^{-6}) target cancer risk level. RBCs for noncancer effects of chemicals are calculated based on a target hazard quotient of 1 (DOE 1994a). General equations for calculating carcinogenic and noncarcinogenic RBCs are

$$\text{Carcinogenic RBC} = \frac{\text{Target Cancer Risk Level}}{\text{Intake Factor} \times \text{Cancer Slope Factor}}$$

$$\text{Noncarcinogenic RBC} = \frac{\text{Target Hazard Index} \times \text{Reference Dose}}{\text{Intake Factor}}$$

The reference doses (RfDs) and cancer slope factors (SFs) are chemical-specific EPA-established toxicity factors (DOE 1994b). Intake factors are an estimation of daily intake of soil, sediment, surface water, or groundwater per kilogram body weight. The exposure parameters and other factors used to derive the intake factors for calculating RBCs are discussed in detail below. All exposure assumptions are EPA standard default values (EPA 1991a). Chemical-specific RBCs for PCOCs are shown in the tables accompanying Section 5.0.

4.1 RESIDENTIAL EXPOSURE TO SOIL AND SEDIMENT

RBCs for residential exposure to chemicals in soil or sediment were calculated assuming ingestion, inhalation of particulates, and external radiation as the exposure routes. To calculate RBCs for carcinogenic effects of chemicals, the target excess lifetime cancer risk is assumed to be 10^{-6} (1 in 1,000,000), the exposure frequency is 350 days/year, exposure duration is 30 years, averaging time is 70 years, the daily inhalation rate for airborne particulates is 20 m³/day, the soil particulate emission factor (for nonvolatile organics and inorganics) is 4.63×10^9 m³/kg soil, and the age-adjusted soil ingestion factor is 114 mg-yr/kg-day.

To calculate RBCs for noncarcinogens in soil, the exposure parameters are the same as those for carcinogenic effects except the averaging time is 30 years and the target hazard index of 1 replaces the target excess cancer risk.

All exposure parameters are EPA standard default exposure assumptions for adult residents, except for the soil ingestion rate, which is a time-weighted average for child and adult exposures. The soil ingestion intake factor takes into account the ingestion of 200 mg/day.

of soil by children ages 0-6, the standard default body weight for children of 15 kg, the adult ingestion rate of 100 mg/day during the remaining 24 years of the 30-year exposure duration, and the default adult body weight of 70 kg

RBCs for radionuclides are calculated using the same intake parameters as the exposure to chemicals with the following exceptions body weight is not included in the equation, the age-adjusted soil ingestion factor is 3,600 mg-yr/day, and a gamma shielding factor of 0.2 and a gamma exposure factor of 1 are included in the equation for external radiation exposure

4.2 RESIDENTIAL EXPOSURE TO POND SURFACE WATER

RBCs for residential exposure to chemicals in pond surface water were calculated assuming incidental ingestion of water during swimming To calculate RBCs for carcinogens, the target excess lifetime cancer risk is 10^{-6} , body weight is 70 kg, averaging time is 70 years, exposure frequency is 7 days/year, exposure duration is 30 years, exposure time is 2.6 hours/day, and the contact rate (ingestion rate) is 0.05 l/hour To calculate RBCs for noncarcinogenic effects, all of the exposure parameters are the same except the averaging time is 30 years and the target hazard index of 1 replaces the target excess lifetime cancer risk

RBCs for radionuclides in pond surface water are calculated using the same target cancer risk, exposure frequency, exposure duration, exposure time, and contact rate used in calculating RBCs for chemical carcinogens All exposure parameters are EPA standard default exposure assumptions for adult residents

4.3 RESIDENTIAL EXPOSURE TO GROUNDWATER

RBCs for residential exposure to chemicals in groundwater were calculated assuming ingestion of groundwater as drinking water and inhalation of VOCs released during domestic use To calculate RBCs for carcinogens, the target excess lifetime cancer risk is 10^{-6} , body weight is 70 kg, averaging time is 70 years, exposure frequency is 350 days/year, exposure duration is 30 years, daily indoor inhalation rate is 15 m³/day, the volatilization factor for VOCs is 0.5 l/m³, and the daily ingestion rate is 2 l/day To calculate RBCs for noncarcinogenic effects, all of the exposure parameters are the same except the averaging

time is 30 years and the target hazard index of 1 replaces the target excess lifetime cancer risk

RBCs for radionuclides in groundwater are calculated using the same target cancer risk, exposure frequency, exposure duration, and daily water ingestion rate used in calculating RBCs for chemical carcinogens. All exposure parameters are EPA standard default exposure assumptions for adult residents.

RISK-BASED SCREENING EVALUATION FOR SOURCE AREAS

5.1 RISK-BASED SCREENING PROCESS

The first step in the risk-based screen is to identify, in each source area, the maximum concentration of each inorganic PCOC detected above a BSL in soil, sediment, pond surface water, and groundwater and the maximum detected concentration of each organic PCOC in each medium. The BSL is equivalent to the background mean plus two standard deviations, BSLs for each medium are listed in Attachment 2. The maximum concentration of the PCOC is divided by the chemical-specific RBC for residential exposure to yield an RBC ratio, as shown in the following equation:

$$\text{RBC Ratio} = \frac{\text{Maximum detected concentration}}{\text{Risk-based concentration}}$$

The chemical-specific ratios in that source area and medium are then summed to provide a ratio sum for the medium. If a receptor is assumed to be exposed to more than one medium in a source area (for example, hypothetical residents are assumed to be exposed to both soil and groundwater), the ratio sums for all relevant media are combined to provide a total ratio sum for that source area. The residential scenario assumes that excavation has taken place prior to residential development and the resident may be exposed to soil to a depth of 12 feet. Therefore, maximum concentrations of PCOCs in soil were identified from samples collected to a depth of 12 feet.

The total ratio sums for cancer or noncancer effects are an indication of potential risks to receptors, assuming long-term exposure to maximum detected concentrations of PCOCs. For carcinogens, a total ratio sum of less than 1 indicates a total excess lifetime cancer risk of less than 10^{-6} (1 in 1,000,000) from long-term exposure to the maximum concentrations of PCOCs in that source area. A total ratio sum for carcinogens that is greater than 1 but less than 100 indicates a total excess lifetime cancer risk between 10^{-6} and 10^{-4} (1 in 10,000), which is the target cancer risk range that EPA has adopted to guide remedial decisions at

hazardous waste sites (40 CFR 300) Where cancer risks estimated in a baseline HHRA do not exceed 10^{-4} , remediation is not generally warranted unless noncarcinogenic effects or ecological risks are significant (EPA 1991b) A total ratio sum for carcinogens that is greater than 100 indicates a potentially unacceptable cancer risk from long-term exposure to maximum detected concentrations For noncarcinogens, a ratio or ratio sum less than or equal to 1 indicates that no toxic effects are expected A noncarcinogenic total ratio greater than 1 indicates a possible cause for concern for noncarcinogenic effects

This risk-based screen is conservative because it is based on the assumption that a long-term resident will be routinely exposed to the maximum concentrations of contaminants found in soil, sediment, pond surface water, and groundwater Therefore, the screen does not confirm that an actual risk exists Ratio sums greater than 1 indicate that the area warrants further evaluation, but the ratios do not indicate that an actual health threat is present

If either the carcinogenic or noncarcinogenic total ratio sum is greater than 100, that source area may be identified by DOE as a candidate for early action Source areas with ratio sums greater than 100, as well as those with ratio sums between 1 and 100, will be evaluated further in the baseline HHRA for OU6 If both the carcinogenic and noncarcinogenic total ratio sums are less than 1, the source area is a candidate for no further action based on human health risk In these cases, the incremental risk from dermal exposure is evaluated to confirm that the total ratio sums, including dermal exposure, are still less than 1

For some source areas (IHSSs) in OU6, a ratio sum above 1 is due solely to groundwater contaminants attributed to known or suspected sources outside of OU6 or to PCOCs in groundwater observed at sampling locations remote from the IHSS (i.e., the groundwater PCOCs are not associated with the IHSS) and where there is no evidence of migration of contamination to the IHSS At these IHSSs, soil or sediment contamination is minimal, and the IHSSs are considered candidates for no further action for soils or sediment The groundwater contamination is proposed to be addressed in other OUs or with other OU6 source areas to be evaluated in the HHRA This condition applies to former IHSS 167 3 (South Spray Field area), IHSSs 166 1-3 (Trenches), and IHSSs 142 4, 142 9, and 142 12 (A-4 Pond, B-5 Pond, and the Walnut and Indiana Pond) More detail is provided in the IHSS-specific sections that follow

5.2 RATIO SUMS FOR SOURCE AREAS

Table 5-1 presents a summary of the ratio sums by medium and the total ratio sum (sum of medium-specific ratios) for each source area in OU6. A brief summary of the results is presented here. More detail is provided in the IHSS-specific sections that follow.

The following IHSSs had ratio sums below 1 for soil or sediment:

IHSS 216 1	East Spray Field
Former IHSS 167 3	South Spray Field Area
IHSSs 166 1,2,3	Trenches
IHSS 142 4	A-4 Pond
IHSS 142 9	B-5 Pond
IHSS 142 12	Walnut & Indiana Pond

However, for all the above IHSSs except IHSS 216 1, which has no associated groundwater, the groundwater ratio sums exceeded 1. As stated previously and detailed in the appropriate sections below, these IHSSs are not thought to be a source of groundwater contamination and may be candidates for no further action for soils or sediments.

The following IHSSs had ratio sums that exceeded 1 for soil or sediment, ratio sums for groundwater, when present, also exceeded 1:

IHSS 167 1	North Spray Field
IHSS 156 2	Soil Dump Area
IHSS 141	Sludge Dispersal Area
IHSS 165	Triangle Area
IHSSs 142 1,2,3	Ponds A-1, A-2, A-3
IHSS 142 5,6,7,8	Ponds B-1, B-2, B-3, B-4
IHSS 143	Old Outfall

These IHSSs will be evaluated further in a baseline HHRA or, in the case of IHSS 143, further assessed in OU8, which includes industrialized portions of RFETS.

5.2.1 IHSS 143 (Old Outfall)

In soil 0 to 12 feet at IHSS 143, 32 PCOCs were detected above BSL. The carcinogenic and noncarcinogenic ratio sums for soil based on residential exposure are $4.7\text{E}+01$ and $1.4\text{E}-01$, respectively (Table 5-2). Benzo(a)anthracene (1.8 mg/kg), benzo(a)pyrene (2.3 mg/kg), benzo(b)fluoranthene (3.2 mg/kg), dibenzo(ah)anthracene (0.2 mg/kg), and indeno(1,2,3-cd)pyrene (0.92 mg/kg) found in the top 2 inches of soil are the greatest contributors to the ratio sum. These analytes are not related to historic wastewater releases at the Old Outfall which is located approximately 10 feet below ground surface. The analytes are most likely due to vehicle emission deposits on surface soil or they were present in the fill brought in to fill and grade the area.

In groundwater, 25 PCOCs were identified above the BSL. Only one well (77492), is located at this source area. Both the carcinogenic ratio sum ($1.8\text{E}+03$) and the noncarcinogenic ratio sum ($9.4\text{E}+01$) exceed 1 (Table 5-3), assuming long-term residential exposure to maximum detected concentrations. 1,1-Dichloroethene (0.0002 mg/l), carbon tetrachloride (0.008 mg/l), chloroform (0.003 mg/l), bis(2-ethylhexyl)phthalate (0.008 mg/l), arsenic (0.016 mg/l), and beryllium (0.027 mg/l) are the major contributors to the carcinogenic ratio sum for groundwater. Arsenic, manganese (5 mg/l), vanadium (0.36 mg/l), and zinc (671 mg/l) are the major contributors to the noncarcinogenic ratio sum for groundwater.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for soil and groundwater. At IHSS 143, the carcinogenic total ratio sum for the hypothetical resident is $1.8\text{E}+03$ and the noncarcinogenic total ratio sum is $9.4\text{E}+01$, as shown on the summary Table 5-1.

5.2.2 IHSS 167.1 (North Spray Field Area)

At IHSS 167.1, 13 PCOCs were detected above the BSL in soil to 12 feet. The carcinogenic ratio sum for soil is $4.9\text{E}+0$ and the noncarcinogenic ratio sum is $5.5\text{E}-02$ (Table 5-4). Uranium-238 (131 pCi/g) is the main contributor to the carcinogenic ratio sum in soil. IHSS 167.1 is outside of any of the six groundwater areas since the wells nearby are dry, and therefore there is no groundwater exposure or ratio sum associated with this IHSS.

5.2.3 IHSSs 166.1, 166.2, 166.3 (Trenches A, B, and C)

At IHSS 166, 15 PCOCs were detected above the BSL in soil to 12 feet. The carcinogenic and noncarcinogenic ratio sums for soil based on a residential exposure are 8.3×10^{-1} and 1.6×10^{-1} , respectively (Table 5-5). IHSS 166 is located in groundwater area 1 (Table 5-6). The carcinogenic ratio based on residential exposure to groundwater is 2.0×10^3 and the noncarcinogenic ratio sum is 7.4×10^1 (Table 5-6). Benzene (0.002 mg/l), carbon tetrachloride (0.008 mg/l), chloroform (0.008 mg/l), methylene chloride (0.032 mg/l), tetrachloroethene (0.013 mg/l), trichloroethene (0.15 mg/l), arsenic (0.01 mg/l), and beryllium (0.032 mg/l) are the main contributors to the carcinogenic ratio sum in groundwater, and nearly all of the PCOC metals contribute significantly to the noncarcinogenic ratio sum.

The total ratio sums for the residential scenario are the sums of the ratios for soil and groundwater. At IHSS 166, the carcinogenic total ratio (2.0×10^3) for the hypothetical resident exposed to soil and groundwater is greater than 100 and the noncarcinogenic total ratio (7.4×10^1) is greater than 1, both are equivalent to the ratio sums for groundwater because the ratio sum for soil does not contribute significantly to the total (see summary Table 5-1).

The trenches are not a likely source of groundwater contamination in area 1. The metals detected in unfiltered groundwater samples are probably naturally occurring and may be associated with elevated total suspended solids (TSS) in the groundwater samples. Elevated levels of TSS can occur when there is insufficient groundwater at the monitoring well to permit adequate development prior to sampling.

The trenches also do not appear to be the source of organic contaminants in groundwater area 1 because the low concentrations of most chlorinated solvents detected in soil (0.02 mg/kg or less) are unlikely to have measurable effects on groundwater. Furthermore, the soil samples exhibiting chlorinated solvent contamination were collected below the water table in borings in Trench A, suggesting groundwater as the source of contaminants in those samples, and more probable sources of groundwater contamination, such as the landfill, are nearby. More detail is provided in the following paragraphs.

Trichloroethene (TCE) was detected at concentrations ranging from 0.006 mg/kg to 0.021 mg/kg in four boreholes drilled in IHSS 166.1, in samples collected at depths ranging from about 7 to 12 feet below ground surface (Figure AT3-1). TCE was detected during the period from March 1991 to October 1993 at two wells located in IHSS 166.1 at concentrations ranging from 0.016 mg/l to 0.150 mg/l. These observations, which indicate higher concentrations of TCE in groundwater than subsurface soils, suggest that the soil is not a likely source of contamination to groundwater. Several other VOCs (1,1,1-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethene, carbon tetrachloride, chloroform, and tetrachloroethene) were detected at low concentrations (the highest was tetrachloroethene at 0.013 mg/l) in groundwater from wells 7287 and B206489, but these chemicals were not detected in subsurface soils in Trench A boreholes, this is additional evidence that soils in the trench are not the source of groundwater contamination.

Furthermore, water level measurements show that the depth to groundwater ranged from 3 to 9 feet at Well 7287 and from 1 to 8 feet at Well B206489 during the period from 1988 to 1993. These measurements indicate that the soil samples in which TCE was detected were collected from intervals that are typically saturated by groundwater. Thus, the groundwater in the vicinity of Trench A may act as a contaminant source to subsurface soils in the area.

5.2.4 Former IHSS 167.3 (South Spray Field Area)

At former IHSS 167.3, nine PCOCs were detected above the BSL in soil to 12 feet. The carcinogenic ratio sum for soil based on residential exposure is 1.1×10^{-1} and the noncarcinogenic ratio sum is 3.8×10^{-3} (Table 5-7).

In samples collected in groundwater area 1, 36 PCOCs were detected above the BSL. 19 metals, nitrate, low concentrations of several chlorinated hydrocarbons and other VOCs. Most maximum concentrations were detected in samples from well 7287 and adjacent well B206489 that are located west of former IHSS 167.3 in IHSS 166.1 (Trench A). The carcinogenic ratio based on residential exposure to maximum detected concentrations of PCOCs in groundwater area 1 is 2.0×10^3 and the noncarcinogenic ratio is 7.4×10^1 (Table 5-6). The major chemical contributors to the ratio sums for groundwater are listed above in Section 5.2.3.

The total ratio sums for the residential scenario are the sums of the ratios for soil and groundwater. At former IHSS 1673, the carcinogenic total ratio sum (2.0×10^3) for the hypothetical resident exposed to soil and groundwater is greater than 100 and the noncarcinogenic total ratio sum (7.4×10^1) is greater than 1, both are equivalent to the ratio sums for groundwater because the ratio sum for soil does not contribute significantly to the total (see summary Table 5-1).

Former IHSS 1673 is not considered a source of contamination to groundwater in area 1 for similar reasons as described above for IHSS 166. The only organic PCOCs detected in soil in this area were methylene chloride, 2-butanone, and toluene (Figure AT3-3). These compounds may be laboratory or field contaminants rather than environmental contaminants. With the exception of methylene chloride, none of the chlorinated solvents or fuel-related constituents such as benzene that were detected in groundwater were found in soil, there is little match between the PCOCs in soil at former IHSS 1673 and groundwater area 1 (Figure AT3-2 and Figure AT3-4). Therefore, it is unlikely that soil at former IHSS 1673 is a source of groundwater contamination.

5.2.5 IHSS 216.1 (East Spray Field)

At IHSS 216.1, 9 PCOCs were detected above the BSL in soil to 12 feet. The carcinogenic and noncarcinogenic ratio sums are 3.5×10^{-1} and 4.4×10^{-2} , respectively (Table 5-8). IHSS 216.1 is outside of any of the groundwater areas so groundwater is not evaluated for this source area.

5.2.6 IHSS 156.2 (Soil Dump Area)

At IHSS 156.2, 20 PCOCs were detected above the BSL in soil to 12 feet. The carcinogenic ratio sum is 1.6×10^0 and the noncarcinogenic ratio sum is 4.8×10^{-1} (Table 5-9). The main contributors to the carcinogenic ratio sum are the radionuclides Am-241, Pu-239,240, and U-235. IHSS 156.2 is outside of any of the groundwater areas, so groundwater is not evaluated for this source area.

5.2.7 IHSS 141 (Sludge Dispersal Area)

At IHSS 141, 14 PCOCs were detected above the BSL in soil to 12 feet. The carcinogenic ratio sum for soil based on residential exposure is 3.8×10^0 and the noncarcinogenic ratio sum is 1.0×10^{-1} (Table 5-10). Pu-239,240, found in the top 2 inches of soil, is the greatest contributor to the ratio sum. In groundwater area 3, 25 PCOCs were identified above the BSL (mostly trace concentrations of chlorinated hydrocarbons). Both the carcinogenic ratio sum for groundwater (3.1×10^4) and the noncarcinogenic ratio sum (2.4×10^1) exceed 1 (Table 5-11) based on long-term residential exposure to maximum detected concentrations: 1,1-Dichloroethene (0.005 mg/l), 1,2-dichloroethane (0.002 mg/l), benzene (0.0009 mg/l), methylene chloride (0.014 mg/l), tetrachloroethene (0.002 mg/l), trichloroethene (0.006 mg/l), and vinyl chloride (0.86 mg/l) are the major contributors to the carcinogenic ratio sum, manganese is the major contributor to the noncarcinogenic ratio sum in groundwater. Most maximum concentrations were observed in samples collected at well 3586, which is located upgradient of IHSS 141 (Sludge Dispersal Area) and about 700 feet upgradient of the B-series ponds. The source of contamination in well 3586 has been under investigation and is not related to IHSSs in OU6. In addition, PCOCs in soil at IHSS 141 do not match the PCOCs in area 3 groundwater. Therefore, IHSS 141 is not considered a source of groundwater contamination.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for soil and groundwater. At IHSS 141, the carcinogenic total ratio sum (3.1×10^4) for the hypothetical resident is greater than 100 and the noncarcinogenic total ratio sum (2.4×10^1) is greater than 1, both are equivalent to the ratio sums for groundwater because the ratio sum for soil does not contribute significantly to the total (see summary Table 5-1). However, the carcinogenic ratio sum for soil, assuming residential exposure, also exceeds 1.

5.2.8 IHSS 165 (Triangle Area)

At IHSS 165, 32 PCOCs were detected above the BSL in soil to 12 feet. The carcinogenic ratio sum for soil based on residential exposure is 1.4×10^1 and the noncarcinogenic ratio sum is 1.1×10^{-1} (Table 5-12). Am-241 (3.24 pCi/g), Pu-239,240 (15.22 pCi/g), and Aroclor-1254 (0.425 mg/kg) found in the top 2 inches of soil and benzo(a)pyrene (0.13 mg/kg in the 0- to

6-foot interval) are the greatest contributors to the carcinogenic ratio sum. In groundwater area 4, 16 PCOCs were identified above the BSL. Both the carcinogenic ratio sum (1.2×10^1) and the noncarcinogenic ratio sum (4.8×10^0) exceed 1 (Table 5-13), based on long-term residential exposure to maximum detected concentrations. Benzene (0.003 mg/l), tetrachloroethene (0.003 mg/l), and trichloroethene (0.004 mg/l) are the major contributors to the carcinogenic ratio sum for groundwater. Manganese (0.53 mg/l) and nitrate (95 mg/l) are the major contributors to the noncarcinogenic ratio sum in groundwater.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for soil and groundwater. At IHSS 165, the carcinogenic and noncarcinogenic total ratio sums for the hypothetical resident are 2.6×10^1 for carcinogens and 4.9×10^0 for noncarcinogens, as shown on the summary Table 5-1).

5.2.9 IHSS 142.1 (A-1 Pond)

At IHSS 142.1, 26 PCOCs were detected above the BSL in pond sediments. The carcinogenic ratio sum based on long-term residential exposure to exposed pond sediment is 2.8×10^1 and the noncarcinogenic ratio sum is 3.2×10^{-2} (Table 5-14). Benzo(a)pyrene (0.31 mg/kg), Aroclor-1254 (0.59 mg/kg), Am-241 (13.23 pCi/g), and Pu-239,240 (36.2 pCi/g) are the main contributors to the carcinogenic ratio sum in pond sediments.

In pond surface water, 5 PCOCs were detected above the BSL. Table 5-15 shows maximum concentrations of all PCOCs detected in surface water in the A-series ponds. The carcinogenic and noncarcinogenic ratio sums for exposure to surface water, based on a residential swimming scenario, were both less than 1.0×10^{-2} (Table 5-15).

Groundwater area 2 (North Walnut Creek Drainage) is associated with the A-series ponds. Forty-two PCOCs were detected above the BSL in groundwater samples collected in the North Walnut Creek Drainage. The carcinogenic and noncarcinogenic ratio sums for groundwater, based on residential exposure are 1.2×10^3 and 5.3×10^1 , respectively (Table 5-16). Benzene (0.002 mg/l), tetrachloroethene (0.002 mg/l), arsenic (0.018 mg/l), beryllium (0.015 mg/l), Am-241 (1.09 pCi/l), cesium-137 (4.5 pCi/l), Pu-239,240 (3.65 pCi/l), and radium-226 (0.72 pCi/l) are the main contributors to the carcinogenic ratio sum. A large

number of metals and nitrate are the main contributors to the noncarcinogenic ratio sum in groundwater

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142 1, the carcinogenic total ratio (1.2×10^3) is greater than 100 and the noncarcinogenic total ratio (5.3×10^1) is greater than 1 (see summary Table 5-1). Both total ratio sums are equivalent to the groundwater ratio sums, because ratio sums for other media do not contribute significantly to the total. However, the carcinogenic ratio sum for sediments assuming residential exposure also exceeds 1.

5.2.10 IHSS 142.2 (A-2 Pond)

At IHSS 142 2, 19 PCOCs were detected above the BSL in pond sediments. The carcinogenic ratio sum, based on long-term residential exposure to exposed pond sediment, is 1.2×10^1 and the noncarcinogenic ratio sum is 4.4×10^{-2} (Table 5-17). Aldrin (0.054 mg/kg), Aroclor-1254 (0.59 mg/kg), and Pu-239,240 (5.65 pCi/g) are the main contributors to the carcinogenic ratio sum in pond sediments. As discussed in Section 5.2.9, the carcinogenic and noncarcinogenic ratio sums for exposure to surface water in the A-series ponds, based on a residential swimming scenario, were both less than 1.0×10^{-2} (Table 5-15).

Groundwater area 2 (North Walnut Creek Drainage) is associated with the A-series ponds. As discussed above in Section 5.2.9, the carcinogenic and noncarcinogenic ratio sums for groundwater, based on residential exposure, are 1.2×10^3 and 5.3×10^1 , respectively (Table 5-16).

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142 2, the carcinogenic total ratio (1.2×10^3) is greater than 100 and the noncarcinogenic total ratio (5.3×10^1) is greater than 1 (see summary Table 5-1). Both total ratio sums are equivalent to the ratio sums for groundwater because the ratio sums for other media do not contribute significantly to the total. However, the carcinogenic ratio sum for sediment, assuming residential exposure, also exceeds 1.

5.2.11 IHSS 142.3 (A-3 Pond)

At IHSS 142.3, 15 PCOCs were detected above the BSL in pond sediments. The carcinogenic ratio sum based on long-term residential exposure to exposed pond sediment is 3.2 and the noncarcinogenic ratio sum is 3.5×10^{-2} (Table 5-18). Benzo(a)pyrene (0.24 mg/kg) is the main contributor to the carcinogenic ratio sum in pond sediments. The carcinogenic and noncarcinogenic ratio sums for exposure to surface water in the A-series ponds, based on a residential swimming scenario, were both less than 1×10^{-2} (Table 5-15).

Groundwater area 2 (North Walnut Creek Drainage) is associated with the A-series ponds. As discussed in Section 5.2.9, the carcinogenic and noncarcinogenic ratio sums for groundwater, based on residential exposure, are 1.2×10^3 and 5.3×10^1 , respectively (Table 5-16).

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142.3, the carcinogenic total ratio (1.2×10^3) is greater than 100 and the noncarcinogenic total ratio (5.3×10^1) is greater than 1 (see summary Table 5-1). Both total ratio sums are equivalent to the ratio sums for groundwater because the ratio sums for other media do not contribute significantly to the total. However, the carcinogenic ratio sum for sediment, assuming residential exposure, also exceeds 1.

5.2.12 IHSS 142.4 (A-4 Pond)

At IHSS 142.4, 12 PCOCs were detected above the BSL in pond sediments. The carcinogenic and noncarcinogenic ratio sums based on long-term residential exposure to exposed pond sediment are 1.7×10^1 and 4.1×10^1 , respectively (Table 5-19). As for the other A-series ponds, the carcinogenic and noncarcinogenic ratio sums for exposure to surface water, based on a residential swimming scenario, were both less than 1×10^{-2} (Table 5-15). The carcinogenic and noncarcinogenic ratio sums for groundwater area 2, based on residential exposure, are 1.2×10^3 and 5.3×10^1 , respectively (Table 5-16).

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142.4,

the carcinogenic total ratio 1.2×10^3 is greater than 100 and the noncarcinogenic total ratio (5.3×10^1) is greater than 1 (see summary Table 5-1), due entirely to PCOCs in groundwater

Sediments in Pond A-4 are not a likely source of groundwater contamination observed in groundwater area 2. Two wells in area 2 (41091 and 1186) are downgradient of Pond A-4. As shown in Table 5-16, fuel-related constituents (such as benzene, ethylbenzene, toluene, and xylenes), styrene, chloroform, and methylene chloride were detected in samples from these wells (Figures AT3-5, AT3-6, and AT3-7). The readily soluble compounds acetone (0.046 mg/kg), benzene (0.003 mg/kg), methylene chloride (0.017 mg/kg) and toluene (0.008 mg/kg) were detected in sediment samples in Pond A-4 (Figures AT3-8 and AT3-9), however, these low concentrations of VOCs are not likely to have measurable effects on groundwater. Bis(2-ethylhexyl)phthalate was also detected in Pond A-4 sediment samples, but this compound would be expected to adhere to sediment particles rather than be transported in aqueous phase in groundwater.

It is concluded that the fuel-related and other organic constituents observed in samples from wells 1186 and 41091 are likely to be due to sources other than sediments in Pond A-4.

5.2.13 IHSS 142.5 (B-1 Pond)

At IHSS 142.5, 35 PCOCs were detected above the BSL in pond sediments. The carcinogenic ratio sum, based on long-term residential exposure to exposed pond sediments, is 3.4×10^2 and the noncarcinogenic ratio sum is 8.2×10^1 (Table 5-20). Aroclor-1254, benzo(a)pyrene (0.87 mg/kg), Am-241, Pu-239,240, and U-235 are the chief contributors to the carcinogenic ratio sum for sediment.

In surface water in the B-series ponds, 11 PCOCs were detected above the BSL. Table 5-21 shows all detected PCOCs in surface water in the B-series ponds. The carcinogenic and noncarcinogenic ratio sums for exposure to surface water, based on a residential swimming scenario, were both less than 2×10^2 (Table 5-21).

Groundwater for area 3 (South Walnut Creek Drainage) is associated with the B-series ponds. Twenty-five PCOCs were detected above the BSL in groundwater samples collected in the South Walnut Creek Drainage. The carcinogenic and noncarcinogenic ratio sums for

groundwater, based on residential exposure, are 3.1×10^4 and 2.4×10^1 , respectively (Table 5-11). As discussed in Section 5.2.7, 1,1-dichloroethene, 1,2-dichloroethane, benzene, methylene chloride, tetrachloroethene, and vinyl chloride are the main contributors to the carcinogenic ratio sum in groundwater. Manganese is the main contributor to the noncarcinogenic ratio sum in groundwater. Most maximum concentrations were observed in samples from well 3586, which is located upgradient of all IHSSs in groundwater area 3 (Figures AT3-10 and AT3-11). Furthermore, PCOCs in pond sediment do not match the PCOCs in area 3 groundwater (Figures AT3-12, AT3-13, and AT3-14). Therefore, Pond B-1 is concluded not to be a source of groundwater contamination and upgradient groundwater contamination does not appear to be migrating down to the B-series ponds.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142.5, the carcinogenic total ratio (3.1×10^4) is greater than 100 and the noncarcinogenic total ratio (2.5×10^1) is greater than 1 (see summary Table 5-1). Both total ratio sums are equivalent to the ratio sum for groundwater because ratio sums for the other media do not contribute significantly to the total. However, the carcinogenic ratio sum for sediment, assuming residential exposure, also exceeds 1.

5.2.14 IHSS 142.6 (B-2 Pond)

At IHSS 142.6, 20 PCOCs were detected above the BSL in pond sediments. The carcinogenic ratio sum based on long-term residential exposure to exposed pond sediments is 1.1×10^2 and the noncarcinogenic ratio sum is 5.0×10^1 (Table 5-22). Aroclor-1254, benzo(a)pyrene (1.5 mg/kg), Am-241, Pu-239,240, and U-235 are the chief contributors to the carcinogenic ratio sum for sediment. As discussed in Section 5.2.13, the carcinogenic and noncarcinogenic ratio sums for exposure to surface water in the B-series ponds, based on a residential swimming scenario, were both less than 2×10^{-2} (Table 5-15), and the carcinogenic and noncarcinogenic ratio sums for groundwater area 3, based on residential exposure, are 3.1×10^4 and 2.4×10^1 , respectively (Table 5-11). The ratio sums for groundwater are largely driven by PCOCs detected in well 3586, which is located upgradient of all IHSSs in groundwater area 3 (Figures AT3-10 and AT3-11). Additionally, PCOCs in pond sediments do not match the PCOCs in area 3 groundwater (Figures AT3-12, AT3-13, and AT3-14).

Therefore, Pond B-2 is not considered a source of groundwater contamination and upgradient groundwater contamination does not appear to be migrating down to the B-series ponds

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142 6, the carcinogenic total ratio (3.1×10^4) is greater than 100 and the noncarcinogenic total ratio (2.4×10^1) is greater than 1 (see summary Table 5-1). Both total ratio sums are equivalent to the ratio sums for groundwater because ratios for the other media do not contribute significantly to the total. However, the carcinogenic ratio sum for sediment, assuming residential exposure, also exceeds 1.

5.2.15 IHSS 142.7 (B-3 Pond)

At IHSS 142 7, 24 PCOCs were detected in pond sediments. The carcinogenic and noncarcinogenic ratio sums, based on residential exposure to pond sediments, are 130 and 1 (Table 5-23). Aroclors (1254 and 1260), Am-241, Pu-239,240, and U-235 are the chief contributors to the carcinogenic ratio sum for sediment. As discussed in Section 5.2.13, the carcinogenic and noncarcinogenic ratio sums for exposure to surface water in the B-series ponds, based on a residential swimming scenario, were both less than 2×10^{-2} (Table 5-15). The carcinogenic and noncarcinogenic ratio sums for groundwater area 3, based on residential exposure, are 3.1×10^4 and 2.4×10^1 , respectively (Table 5-11). The ratio sums for groundwater are largely driven by PCOCs detected in well 3586, which is upgradient of IHSSs included in groundwater area 3. For the reasons discussed previously, the ponds are not considered sources of groundwater contamination and upgradient groundwater contamination does not appear to be migrating down to the B-series ponds.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142 7, the carcinogenic total ratio (3.1×10^4) is greater than 100 and the noncarcinogenic total ratio (2.5×10^1) is greater than 1 (see summary Table 5-1). Both total ratio sums are equivalent to the ratio sums for groundwater because the ratios for the other media do not contribute significantly to the total. However, the carcinogenic ratio sum for sediment, assuming residential exposure, also exceeds 1.

5.2.16 IHSS 142.8 (B-4 Pond)

At IHSS 142.8, 30 PCOCs were detected above the BSL in pond sediments. The carcinogenic ratio sum, based on long-term residential exposure to exposed pond sediments, is 3.4×10^1 and the noncarcinogenic ratio sum is 1.4×10^{-1} (Table 5-24). Benzo(a)pyrene (0.57 mg/kg), benzo(b)fluoranthene (1.5 mg/kg), Aroclor-1254 (13 mg/kg), Am-241 (3.1 pCi/g), and Pu-239/240 (7 pCi/g) are the chief contributors to the carcinogenic ratio sum for sediment. As discussed in Section 5.2.13, the carcinogenic and noncarcinogenic ratio sums for exposure to surface water in the B-series ponds, based on a residential swimming scenario, were both less than 2×10^{-2} (Table 5-15). The carcinogenic and noncarcinogenic ratio sums for groundwater area 3, based on residential exposure, are 3.1×10^4 and 2.4×10^1 , respectively (Table 5-11). The ratio sums for groundwater are largely driven by PCOCs detected in well 3586, which is upgradient of IHSSs included in groundwater area 3 (Figures AT3-10 and AT3-11). For reasons previously discussed (see Section 5.2.14), Pond B-4 is not considered a source of groundwater contamination and upgradient groundwater contamination does not appear to be migrating down to the B-series ponds.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142.8, the carcinogenic total ratio (3.1×10^4) is greater than 100 and the noncarcinogenic total ratio (2.4×10^1) is greater than 1 (see summary Table 5-1). Both total ratio sums are equivalent to the ratio sums for groundwater because ratios for the other media do not contribute significantly to the total. However, the carcinogenic ratio sum for sediment, assuming residential exposure, also exceeds 1.

5.2.17 IHSS 142.9 (B-5 Pond)

At IHSS 142.9, 12 PCOCs were detected above the BSL in pond sediments. The carcinogenic and noncarcinogenic ratio sums, based on long-term residential exposure to exposed pond sediments, are less than 1 (Table 5-25). As discussed in Section 5.2.13, the carcinogenic and noncarcinogenic ratio sums for exposure to surface water in the B-series ponds, based on a residential swimming scenario, were both less than 2×10^{-2} (Table 5-15). The carcinogenic and noncarcinogenic ratio sums for groundwater area 3, based on residential exposure, are 3.1×10^4 and 2.4×10^1 , respectively (Table 5-11). The ratio sums for

groundwater are largely driven by PCOCs detected in upgradient well 3586 (Figures AT3-10 and AT3-11). For reasons previously discussed (see Section 5.2.14), Pond B-5 is not considered a source of groundwater contamination (Figures AT3-12, AT3-13, and AT3-14) and upgradient groundwater contamination does not appear to be migrating down to the B-series ponds. In addition, the wells nearest Pond B-5 have extremely low levels of PCOCs.

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142.9, the carcinogenic total ratio (3.1×10^4) is greater than 100 and the noncarcinogenic total ratio (2.4×10^1) is greater than 1 (see summary Table 5-1), due entirely to PCOCs in groundwater.

5.2.18 IHSS 142.12 (Walnut and Indiana Pond)

At IHSS 142.12, seven PCOCs were detected above the BSL in pond sediments. The carcinogenic and noncarcinogenic ratio sums, based on long-term residential exposure to exposed pond sediments, are less than 1 (Table 5-26). In surface water at this pond, one PCOC (acetone) was detected (maximum concentration of 0.14 mg/l). The noncarcinogenic ratio sum for exposure to acetone in surface water, based on a residential swimming scenario, is less than 1 (Table 5-27). In groundwater samples collected from wells at Indiana Street (groundwater area 5), 24 PCOCs were detected above the BSL. The carcinogenic and noncarcinogenic ratio sums for groundwater, based on residential exposure, are 6.5×10^2 and 3.4×10^1 , respectively (Table 5-28). Methylene chloride (0.01 mg/l), arsenic (0.008 mg/l), beryllium (0.008 mg/l), Am-241 (3.2 pCi/l), Pu-239,240 (2.204 pCi/l), radium-226 (1.1 pCi/l), and strontium-89,90 (1.049 pCi/l) are the main contributors to the carcinogenic ratio sum in groundwater. Antimony (0.194 mg/l), manganese (3.19 mg/l) and vanadium (0.312 mg/l) are the main contributors to the noncarcinogenic ratio sum in groundwater. These constituents were not PCOCs in the Walnut and Indiana Pond sediment, except for methylene chloride (maximum sediment concentration = 0.02 mg/kg).

The total carcinogenic and noncarcinogenic ratio sums for the residential scenario are the sums of the ratios for pond sediment, pond surface water, and groundwater. At IHSS 142.12, the carcinogenic total ratio (6.5×10^2) is greater than 100 and the noncarcinogenic total ratio (3.4×10^1) is greater than 1 (see summary Table 5-1), due entirely to PCOCs (chiefly arsenic and beryllium) in unfiltered groundwater samples collected in wells at Indiana Street. The

Walnut and Indiana Pond sediments are probably not a source of groundwater contamination in these wells

5.2.19 Stream Sediments

Tables 5-29 through 5-32 show the RBC screen results for stream sediment samples from four stream segments North Walnut Creek Drainage, South Walnut Creek Drainage, Walnut and Indiana effluent, and Upgradient of OU6 in the North Walnut Creek drainage The stream sediment data are evaluated separately since they were not assigned to any particular source area. However, the stream sediment data will be incorporated, if appropriate, into data sets for the appropriate areas of concern to be evaluated in the baseline HHRA

Maximum concentrations of PCOCs in stream sediments were compared to residential soil RBCs Eleven PCOCs were detected above the BSL in the sediments in the North Walnut Creek Drainage The carcinogenic ratio sum is $1.4E+0$ and the noncarcinogenic ratio sum is $7.3E-01$ (Table 5-29) Benzo(a)pyrene (0.11 mg/kg) is the main contributor to the carcinogenic ratio sum

Seventeen PCOCs were detected above the BSL in the sediments in the South Walnut Creek Drainage The carcinogenic ratio sum is $6.9E+0$ and the noncarcinogenic ratio sum is $2.3E-04$ (Table 5-30) Benzo(a)pyrene (0.48 mg/L) is the main contributor to the carcinogenic ratio sum

Four PCOCs were detected above the BSL in the sediments at the Walnut and Indiana Pond effluent The carcinogenic and noncarcinogenic ratio sums are $3.7E-03$ and $3.3E-05$, respectively (Table 5-31)

Thirteen PCOCs were detected above the BSL in the two stream sediment samples collected upgradient of OU6 in the North Walnut Creek drainage The carcinogenic ratio sum is $2.8E+0$ and the noncarcinogenic ratio sum is $8.2E-05$ (Table 5-32) Benzo(a)pyrene (0.17 mg/kg) is the main contributor to the carcinogenic ratio sum

5.2.20 Dry Sediments

Tables 5-33 and 5-34 show the RBC screen results for dry sediments in the North and South Walnut Creek drainages. The dry sediment data are evaluated separately since they were not assigned to any of the source areas. However, the dry sediment data will be incorporated into the data sets for HHRA areas of concern that include ponds.

Maximum concentrations of PCOCs in dry sediments were compared to residential soil RBCs. In the North Walnut Creek drainage, there were 19 PCOCs detected above the BSL in dry sediments. The carcinogenic ratio sum based on residential exposure is $5.3E+0$ and the noncarcinogenic ratio sum is $1.3E-02$ (Table 5-33). Benzo(a)pyrene (0.26 mg/kg) and Pu-239,240 (4.44 pCi/g) are the main contributors to the carcinogenic ratio sum.

In the South Walnut Creek drainage, 20 PCOCs were detected above the BSL in the dry sediments. The carcinogenic ratio sum is $6.9E+0$ and the noncarcinogenic ratio sum is $9.0E-03$ (Table 5-34). Benzo(a)pyrene (0.38 mg/kg) is the main contributor to the carcinogenic ratio sum.

TABLE 5-1
ROCKY FLATS OU6
SUMMARY TOTAL RATIO SUMS BY SOURCE AREA

Source Areas		Medium	Carcinogenic Ratio Sum ⁽¹⁾	Noncarcinogenic Ratio Sum ⁽¹⁾
IHSS 143	Old Outfall	Soil 0-12' -	4 7E+01	1 4E-01
		Groundwater Area 6	1 8E+03	9 4E+01
		Total Ratio Sum	1 8E+03	9 4E+01
IHSS 167 1	North Spray Field	Soil 0-12'	4 9E+00	5 5E-02
		Total Ratio Sum		
Former IHSS 167 3	South Spray Field Area	Soil 0-12'	1 1E-01	3 8E-03
		Groundwater Area 1	2 0E+03	7 4E+01
		Total Ratio Sum	2 0E+03	7 4E+01
IHSSs 166 1, 166 2 and 166 3	Trenches A, B, and C	Soil 0-12'	8 3E-01	1 6E-01
		Groundwater Area 1	2 0E+03	7 4E+01
		Total Ratio Sum	2 0E+03	7 4E+01
IHSS 216 1	East Spray Field	Soil 0-12'	3 5E-01	4 4E-02
IHSS 156 2	Soil Dump Area	Soil 0-12'	1 6E+00	4 8E-01
IHSS 141	Sludge Dispersal	Soil 0-12'	3 8E+00	1 0E-01
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 4E+01
IHSS 165	Triangle Area	Soil 0-12'	1 4E+01	1 1E-01
		Groundwater Area 4	1 2E+01	4 8E+00
		Total Ratio Sum	2 6E+01	4 9E+00
IHSS 142 1	A-1 pond	Sediment	2 8E+01	3 2E-02
		Surface water	3 7E-03	2 3E-04
		Groundwater Area 2	1 2E+03	5 3E+01
		Total Ratio Sum	1 2E+03	5 3E+01
IHSS 142 2	A-2 pond	Sediment	1 2E+01	4 4E-02
		Surface water	3 7E-03	2 3E-04
		Groundwater Area 2	1 2E+03	5 3E+01
		Total Ratio Sum	1 2E+03	5 3E+01
IHSS 142 3	A-3 pond	Sediment	3 2E+00	3 5E-02
		Surface water	3 7E-03	2 3E-04
		Groundwater Area 2	1 2E+03	5 3E+01
		Total Ratio Sum	1 2E+03	5 3E+01

TABLE 5-1
(concluded)

Source Areas		Medium	Carcinogenic Ratio Sum ⁽¹⁾	Noncarcinogenic Ratio Sum ⁽¹⁾
IHSS 142 4	A-4 pond	Sediment	1 7E-01	4 1E-01
		Surface water	3 7E-03	2 3E-04
		Groundwater Area 2	1 2E+03	5 3E+01
		Total Ratio Sum	1 2E+03	5 3E+01
IHSS 142 5	B-1 pond	Sediment	3 4E+02	8 0E-01
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 5E+01
IHSS 142 6	B-2 pond	Sediment	1 1E+02	5 0E-01
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 4E+01
IHSS 142 7	B-3 pond	Sediment	1 3E+02	1 0E+00
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 5E+01
IHSS 142 8	B-4 pond	Sediment	3 4E+01	1 4E-01
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 4E+01
IHSS 142 9	B-5 pond	Sediment	2 6E-01	2 5E-03
		Surface water	1 8E-02	7 8E-05
		Groundwater Area 3	3 1E+04	2 4E+01
		Total Ratio Sum	3 1E+04	2 4E+01
IHSS 142 12	Walnut & Indiana Pond	Sediment	3 1E-03	3 4E-05
		Surface Water	-	5 0E-05
		Groundwater	6 5E+02	3 4E+01
		Total Ratio Sum	6 5E+02	3 4E+01
	Stream Sediment	North Walnut	1 4E+00	7 3E-01
		South Walnut	6 9E+00	2 3E-04
		Upgradient	2 8E+00	8 2E-05
		W&I	3 7E-03	3 3E-05
	Dry Sediment	North Walnut	5 3E+00	1 3E-02
		South Walnut	6 9E+00	9 0E-03

⁽¹⁾ For the CDPHE Conservative Screen

Carcinogenic Ratio Sum >1 is equivalent to >10⁻⁶ cancer risk level

Carcinogenic Ratio Sum >100 is equivalent to >10⁻⁴ cancer risk level

Noncarcinogenic Ratio Sum >1 is equivalent to Hazard Index >1

(All assuming long term residential exposure to maximum detected concentrations of chemicals)

TABLE 5-2
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 143 (OLD OUTFALL)
SOILS 0 TO 12 FEET

Analyte ¹	Maximum Concentration or Activity	Depth of Sample (in ft)	Residential Soil RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)						
2-Butanone	0 018	7 - 8	-	1 65E+05	-	1 1E-07
Acetone	0 17	7 - 8	-	2 74E+04	-	6 2E-06
Acenaphthene	0 51	0	-	1 65E+04	-	3 1E-05
Anthracene	0 66	0	-	8 23E+04	-	8 0E-06
Benzo(a)anthracene	1 8	0	8 77E-01	-	2 1E+00	-
Benzo(a)pyrene	2 3	0	8 77E-02	-	2 6E+01	-
Benzo(b)fluoranthene	3 2	0	8 77E-01	-	3 6E+00	-
Benzo(ghi)perylene	0 89	0	-	-	-	-
Benzo(k)fluoranthene	1 2	0	8 77E+00	-	1 4E-01	-
Benzoic acid	1 065	7 - 11	-	1 10E+06	-	9 7E-07
Bis(2-ethylhexyl)phthalate	0 41	7 - 11	4 57E+01	5 49E+03	9 0E-03	7 5E-05
Chrysene	1 6	0	8 77E+01	-	1 8E-02	-
Dibenz(a,h)anthracene	0 2	0	8 77E-02	-	2 3E+00	-
Dibenzofuran	0 085	0	-	-	-	-
Di-n-octyl phthalate	0 068	0	-	5 49E+03	-	1 2E-05
Fluoranthene	3 1	0	-	1 10E+04	-	2 8E-04
Fluorene	0 24	0	-	1 10E+04	-	2 2E-05
Indeno(1,2,3-cd)pyrene	0 92	0	8 77E-01	-	1 0E+00	-
Methylene chloride	0 013	8 - 9	8 54E+01	1 65E+04	1 5E-04	7 9E-07
Naphthalene	0 12	0	-	1 10E+04	-	1 1E-05
Phenanthrene	1 8	0	-	-	-	-
Pyrene	2 9	0	-	8 23E+03	-	3 5E-04
Toluene	1 055	8 - 9	-	5 49E+04	-	1 9E-05
Pesticides/PCBs (mg/kg)						
Aroclor-1254	0 94	0 - 7	8 32E-02	1 92E+01	1 1E+01	4 9E-02
Inorganics (mg/kg)						
Barium	1150	7 - 12	-	1 92E+04	-	6 0E-02
Nickel	20 3	0	-	5 49E+03	-	3 7E-03
Strontium	279	8 -12	-	1 65E+05	-	1 7E-03
Vanadium	45 5	0	-	1 92E+03	-	2 4E-02
Zinc	85 4	0	-	8 23E+04	-	1 0E-03
Radionuclides² (pCi/g)						
Americium-241	0 0361	7 - 10	2 37E+00	-	1 5E-02	-
Plutonium-239,240	0 5178	0	3 42E+00	-	1 5E-01	-
Uranium-238	1 518	7 - 10	4 60E+01	-	3 3E-02	-
Ratio Sum					4 7E+01	1 4E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-3
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 143 (GW-6)
UHSU GROUNDWATER (UNFILTERED)
(ALL SAMPLES FROM WELL #77492)

Analyte ¹	Maximum Concentration or Activity	Residential Groundwater RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/l)					
1,1-Dichloroethane	0 0006	-	1 01E+00	-	5 9E-04
1,1-Dichloroethene	0 0002	1 67E-05	3 28E-01	1 2E+01	6 1E-04
1,2-Dichloroethene	0 0007	-	3 28E-01	-	2 1E-03
Carbon tetrachloride	0 008	2 60E-04	2 55E-02	3 1E+01	3 1E-01
Chloroform	0 003	2 76E-04	3 65E-01	1 1E+01	8 2E-03
Tetrachloroethene	0 0007	1 43E-03	3 65E-01	4 9E-01	1 9E-03
Trichloroethene	0 0001	2 55E-03	-	3 9E-02	-
Bis(2-ethylhexyl)phthalate	0 008	6 07E-03	7 30E-01	1 3E+00	1 1E-02
				5 5E+01	3 4E-01
Inorganics (mg/l)					
Aluminum	97 7	-	-	-	-
Arsenic	0 0164	4 86E-05	1 09E-02	3 4E+02	1 5E+00
Barium	2 47	-	2 56E+00	-	9 6E-01
Beryllium	0 0266	1 98E-05	1 82E-01	1 3E+03	1 5E-01
Chromium	0 216	-	3 65E+01	-	5 9E-03
Cobalt	0 0932	-	-	-	-
Copper	0 185	-	1 46E+00	-	1 3E-01
Lead	0 176	-	-	-	-
Lithium	0 171	-	-	-	-
Manganese	5 05	-	1 82E-01	-	2 8E+01
Mercury	0 0015	-	1 09E-02	-	1 4E-01
Nickel	0 22	-	7 30E-01	-	3 0E-01
Strontium	1 79	-	2 19E+01	-	8 2E-02
Vanadium	0 365	-	2 56E-01	-	1 4E+00
Zinc	671	-	1 09E+01	-	6 2E+01
				1 7E+03	9 4E+01
Radionuclides² (pCi/l)					
Americium-241	0 04	1 98E-01	-	2 0E-01	-
Radium-226	8 8	3 97E-01	-	2 2E+01	-
				2 2E+01	-
Ratio Sum				1 8E+03	9 4E+01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used

TABLE 5-4
ROCKY FLATS OU6
RBC SCREEN FOR 167.1 (NORTH SPRAY FIELD)
SOILS 0 TO 12 FEET

Analyte ¹	Maximum Concentration or Activity	Depth of Sample (in ft)	Residential Soil RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)						
Toluene	0 003	7 - 8	-	5 49E+04	-	5 5E-08
Inorganics (mg/kg)						
Barium	866	2 - 4	-	1 92E+04	-	4 5E-02
Chromium	217	0	-	2 74E+05	-	7 9E-04
Cobalt	20 3	0	-	-	-	-
Lead	60 1	0	-	-	-	-
Mercury	0 13	0	-	8 23E+01	-	1 6E-03
Nickel	20 6	0	-	5 49E+03	-	3 8E-03
Zinc	287	2 - 4	-	8 23E+04	-	3 5E-03
Radionuclides² (pCi/g)						
Americium-241	1 147	0	2 37E+00	-	4 8E-01	-
Plutonium-239,240	1 849	0	3 42E+00	-	5 4E-01	-
Uranium-233,234	3 05	2 - 4	4 47E+01	-	6 8E-02	-
Uranium-235	0 137	2 - 4	1 73E-01	-	7 9E-01	-
Uranium-238	141	2 - 4	4 60E+01	-	3 1E+00	-
Ratio Sum					4 9E+00	5 5E-02

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-5
ROCKY FLATS OU6
RBC SCREEN FOR IHSS: 166.1, 166.2, & 166.3 (TRENCHES)
SOILS 0 TO 12 FEET

Analyte ¹	Maximum Concentration or Activity	Depth of Sample (in ft)	Residential Soil RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)						
Acetone	4.3	11 - 12	-	2.74E+04	-	1.6E-04
Benzene	0.006	8 - 9	2.21E+01	-	2.7E-04	-
2-Butanone	1.6	4 - 5	-	1.65E+05	-	9.7E-06
Chloroform	0.002	7 - 8	1.05E+02	2.74E+03	1.9E-05	7.3E-07
4-Methyl-2-pentanone	0.002	11 - 12	-	1.37E+04	-	1.5E-07
Methylene chloride	3.7	11 - 12	8.54E+01	1.65E+04	4.3E-02	2.2E-04
Styrene	0.001	0	-	5.49E+04	-	1.8E-08
Trichloroethene	0.021	0	5.82E+01	-	3.6E-04	-
Toluene	0.59	0 - 1	-	5.49E+04	-	1.1E-05
Inorganics (mg/kg)						
Barium	2970	6 - 12	-	1.92E+04	-	1.5E-01
Chromium	130	6 - 12	-	2.74E+05	-	4.7E-04
Strontium	264	0 - 6	-	1.65E+05	-	1.6E-03
Radionuclides ² (pCi/g)						
Americium-241	0.0229	11 - 12	2.37E+00	-	9.7E-03	-
Plutonium-239,240	0.0855	11 - 12	3.42E+00	-	2.5E-02	-
Uranium-235	0.13	0 - 6	1.73E-01	-	7.5E-01	-
Ratio Sum					8.3E-01	1.6E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-6
ROCKY FLATS OU6
RBC SCREEN FOR UNNAMED TRIBUTARY DRAINAGE (GW-1)
UHSU GROUNDWATER (UNFILTERED)

Analyte ¹	Maximum Concentration or Activity	Well ID	Residential		Ratio of Concentration to RBC	
			Groundwater RBCs		Carcinogen	Noncarcinogen
			Carcinogen	Noncarcinogen		
Organics (mg/l)						
1,1,1-Trichloroethane	0 007	7287	-	-	-	-
1,1-Dichloroethane	0 005	B206489	-	1 01E+00	-	5 0E-03
1,2-Dichloroethene	0 006	7287	-	3 28E-01	-	1 8E-02
Acetone	0 017	7087	-	3 65E+00	-	4 7E-03
Benzene	0 002	0586, B206489	6 15E-04	-	3 3E+00	-
Carbon disulfide	0 004	7087	-	2 76E-02	-	1 4E-01
Carbon tetrachloride	0 008	7287	2 60E-04	2 55E-02	3 1E+01	3 1E-01
Chloroform	0 008	7287	2 76E-04	3 65E-01	2 9E+01	2 2E-02
Ethylbenzene	0 0009	0586	-	1 58E+00	-	5 7E-04
Methylene chloride	0 032	7187	6 22E-03	1 73E+00	5 1E+00	1 8E-02
Tetrachloroethene	0 013	7287	1 43E-03	3 65E-01	9 1E+00	3 6E-02
Toluene	0 01	0586	-	9 65E-01	-	1 0E-02
Total xylenes	0 004	0586, B206489	-	7 30E+01	-	5 5E-05
Trichloroethene	0 15	7287	2 55E-03	-	5 9E+01	-
					1 4E+02	5 7E-01
Inorganics (mg/l)						
Aluminum	456	7287	-	-	-	-
Antimony	0 0614	7287	-	1 46E-02	-	4 2E+00
Arsenic	0 0099	7287	4 86E-05	1 09E-02	2 0E+02	9 1E-01
Barium	5 06	7287	-	2 56E+00	-	2 0E+00
Beryllium	0 032	7287	1 98E-05	1 82E-01	1 6E+03	1 8E-01
Cadmium	0 019	7287	-	1 82E-02	-	1 0E+00
Chromium	0 58	7287	-	3 65E+01	-	1 6E-02
Cobalt	0 228	7287	-	-	-	-
Copper	6 43	7287	-	1 46E+00	-	4 4E+00
Lead	0 193	7287	-	-	-	-
Lithium	0 399	0686	-	-	-	-
Manganese	6 2	7287	-	1 82E-01	-	3 4E+01
Mercury	0 0014	7287	-	1 09E-02	-	1 3E-01
Nickel	1 07	7287	-	7 30E-01	-	1 5E+00
Selenium	0 27	0686	-	1 82E-01	-	1 5E+00
Silver	3 04	7287	-	1 82E-01	-	1 7E+01
Strontium	2 78	0686	-	2 19E+01	-	1 3E-01
Vanadium	0 754	7287	-	2 56E-01	-	2 9E+00
Zinc	8	7287	-	1 09E+01	-	7 3E-01
Nitrate	172	B246289	-	5 84E+01	-	2 9E+00
					1 8E+03	7 3E+01

TABLE 5-6
(concluded)

Analyte ¹	Maximum Concentration or Activity	Well ID	Residential Groundwater RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Radionuclides² (pCi/l)						
Americium-241	0 0607	7187	1 98E-01	-	3 1E-01	-
Cesium-137	1 063	7287	1 70E+00	-	6 3E-01	-
					9 3E-01	-
			Ratio Sum		2 0E+03	7 4E+01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-7
ROCKY FLATS OU6
RBC SCREEN FOR FORMER IHSS 167.3 (SOUTH SPRAY FIELD)
SOILS 0 TO 12 FEET

Analyte ¹	Maximum Concentration or Activity	Depth of Sample (in ft)	Residential Soil RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)						
2-Butanone	0.74	4 - 6	-	1.65E+05	-	4.5E-06
Methylene chloride	0.005	0 - 2	8.54E+01	1.65E+04	5.9E-05	3.0E-07
Toluene	0.091	0 - 2	-	5.49E+04	-	1.7E-06
Inorganics (mg/kg)						
Chromium	72	0 - 2	-	2.74E+05	-	2.6E-04
Lead	68.7	0	-	-	-	-
Strontium	341	2 - 4	-	1.65E+05	-	2.1E-03
Zinc	119	0	-	8.23E+04	-	1.4E-03
Radionuclides² (pCi/g)						
Americium-241	0.06413	0	2.37E+00	-	2.7E-02	-
Plutonium-239,240	0.2947	0	3.42E+00	-	8.6E-02	-
Ratio Sum					1.1E-01	3.8E-03

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-8
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 216.1 (EAST SPRAY FIELD)
SOILS 0 TO 12 FEET

Analyte ¹	Maximum Concentration or Activity	Depth of Sample (in ft)	Residential Soil RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)						
Acetone	5.1	1 - 2	-	2.74E+04	-	1.9E-04
2-Butanone	3.7	1 - 2	-	1.65E+05	-	2.2E-05
Methylene chloride	3.75	1 - 2	8.54E+01	1.65E+04	4.4E-02	2.3E-04
Toluene	0.63	1 - 2	-	5.49E+04	-	1.1E-05
Inorganics (mg/kg)						
Barium	783	0 - 2	-	1.92E+04	-	4.1E-02
Lead	57.1	0	-	-	-	-
Strontium	506	2 - 4	-	1.65E+05	-	3.1E-03
Radionuclides ² (pCi/g)						
Americium-241	0.192	0	2.37E+00	-	8.1E-02	-
Plutonium-239,240	0.758	0	3.42E+00	-	2.2E-01	-
Ratio Sum					3.5E-01	4.4E-02

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-9
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 156.2 (SOIL DUMP AREA)
SOILS 0 TO 12 FEET

Analyte ¹	Maximum Concentration or Activity	Depth of Sample (in ft)	Residential Soil RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)						
Acetone	2.1	9 - 10	-	2.74E+04	-	7.7E-05
2-Butanone	1.2	5 - 6	-	1.65E+05	-	7.3E-06
Chlorobenzene	0.074	1 - 2	-	5.49E+03	-	1.3E-05
Methylene chloride	3.6	8 - 9	8.54E+01	1.65E+04	4.2E-02	2.2E-04
4-Methyl-2-pentanone	0.004	9 - 10	-	1.37E+04	-	2.9E-07
Toluene	0.4	1 - 2	-	5.49E+04	-	7.3E-06
Xylenes, total	0.002	9 - 10	-	5.49E+05	-	3.6E-09
Inorganics (mg/kg)						
Antimony	43.6	0	-	1.10E+02	-	4.0E-01
Barium	636	8 - 12	-	1.92E+04	-	3.3E-02
Chromium	23.8	0	-	2.74E+05	-	8.7E-05
Copper	31.7	0	-	1.10E+04	-	2.9E-03
Lead	84.9	0 - 6	-	-	-	-
Mercury	0.14	0	-	8.23E+01	-	1.7E-03
Nickel	21.2	0	-	5.49E+03	-	3.9E-03
Strontium	267	6 - 12	-	1.65E+05	-	1.6E-03
Vanadium	65.1	0	-	1.92E+03	-	3.4E-02
Zinc	706	6 - 12	-	8.23E+04	-	8.6E-03
Radionuclides ² (pCi/g)						
Americium-241	0.31	0 - 6	2.37E+00	-	1.3E-01	-
Plutonium-239,240	1.85	0	3.42E+00	-	5.4E-01	-
Uranium-235	0.16	0 - 6	1.73E-01	-	9.2E-01	-
Ratio Sum					1.6E+00	4.8E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-10
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 141 (SLUDGE DISPERSAL)
SOILS 0 TO 12 FEET

Analyte ¹	Maximum Concentration or Activity	Depth of Sample (in ft)	Residential Soil RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)						
2-Butanone	2	8 - 9	-	1 65E+05	-	1 2E-05
Toluene	0 18	8 - 9	-	5 49E+04	-	3 3E-06
Inorganics (mg/kg)						
Chromium	20 6	0	-	2 74E+05	-	7 5E-05
Cobalt	18 8	0	-	-	-	-
Copper	61 6	0	-	1 10E+04	-	5 6E-03
Lead	62	0	-	-	-	-
Mercury	0 34	0	-	8 23E+01	-	4 1E-03
Nickel	22 5	0	-	5 49E+03	-	4 1E-03
Silver	52 7	0	-	1 37E+03	-	3 8E-02
Strontium	104	0	-	1 65E+05	-	6 3E-04
Vanadium	75 9	0	-	1 92E+03	-	4 0E-02
Zinc	650	0	-	8 23E+04	-	7 9E-03
Radionuclides ² (pCi/g)						
Americium-241	1 842	0	2 37E+00	-	7 8E-01	-
Plutonium-239,240	10 38	0	3 42E+00	-	3 0E+00	-
Ratio Sum					3 8E+00	1 0E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used

TABLE 5-11
ROCKY FLATS OU6
RBC SCREEN FOR SOUTH WALNUT CREEK DRAINAGE (GW-3)
UHSU GROUNDWATER (UNFILTERED)

Analyte ¹	Maximum Concentration or Activity	Well ID	Residential Groundwater RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/l)						
1,1,1-Trichloroethane	0 012	3586	-	-	-	-
1,1-Dichloroethane	0 062	3586	-	1 01E+00	-	6 1E-02
1,1-Dichloroethene	0 005	3586	1 67E-05	3 28E-01	3 0E+02	1 5E-02
1,2-Dichloroethane	0 002	3586	1 97E-04	-	1 0E+01	-
1,2-Dichloroethene	0 074	3586	-	3 28E-01	-	2 3E-01
Acetone	0 008	3786	-	3 65E+00	-	2 2E-03
Benzene	0 0009	3586	6 15E-04	-	1 5E+00	-
Chloromethane	0 00025	02691	2 32E-03	-	1 1E-01	-
2-Hexanone	0 005	3586	-	-	-	-
4-Isopropyltoluene	0 00013	02691	-	-	-	-
4-Methyl-2-pentanone	0 001	3586	-	1 98E-01	-	5 1E-03
Methylene chloride	0 014	02691	6 22E-03	1 73E+00	2 3E+00	8 1E-03
Tetrachloroethene	0 0022	02691	1 43E-03	3 65E-01	1 5E+00	6 0E-03
Toluene	0 00015	3786	-	9 65E-01	-	1 6E-04
trans-1,2-dichloroethene	0 009	3586	-	-	-	-
Trichloroethene	0 006	3586	2 55E-03	-	2 4E+00	-
Vinyl chloride	0 86	3586	2 81E-05	-	3 1E+04	-
					3 1E+04	3 2E-01
Inorganics (mg/l)						
Barium	0 337	02691	-	2 56E+00	-	1 3E-01
Lead	0 0173	02691	-	-	-	-
Manganese	4 17	3586	-	1 82E-01	-	2 3E+01
Mercury	0 00024	3586	-	1 09E-02	-	2 2E-02
Strontium	2 02	3886	-	2 19E+01	-	9 2E-02
Zinc	0 138	02691	-	1 09E+01	-	1 3E-02
Nitrates	17 68	02691	-	5 84E+01	-	3 0E-01
					-	2 3E+01
Radionuclides¹ (pCi/l)						
Strontium-89,90	1 22	02691	1 44E+00	-	8 5E-01	-
					8 5E-01	-
Ratio Sum					3 1E+04	2 4E+01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-12
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 165 (TRIANGLE AREA)
SOILS 0 TO 12 FEET

Analyte ¹	Maximum Concentration or Activity	Depth of Sample (in ft)	Residential Soil RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)						
2-Butanone	0.56	11 - 12	-	1.65E+05	-	3.4E-06
Acetone	0.26	1 - 2	-	2.74E+04	-	9.5E-06
Benzo(a)anthracene	0.099	0 - 6	8.77E-01	-	1.1E-01	-
Benzo(a)pyrene	0.13	0 - 6	8.77E-02	-	1.5E+00	-
Benzo(b)fluoranthene	0.17	0 - 6	8.77E-01	-	1.9E-01	-
Benzo(k)fluoranthene	0.06	0 - 6	8.77E+00	-	6.8E-03	-
Benzene	0.003	1 - 2	2.21E+01	-	1.4E-04	-
Benzoic acid	0.26	0 - 6	-	1.10E+06	-	2.4E-07
Bis(2-ethylhexyl)phthalate	0.35	0 - 5	4.57E+01	5.49E+03	7.7E-03	6.4E-05
2-Chlorophenol	0.044	6 - 12	-	1.37E+03	-	3.2E-05
Chrysene	0.12	0 - 6	8.77E+01	-	1.4E-03	-
1,4-Dichlorobenzene	0.064	0 - 4	2.67E+01	-	2.4E-03	-
Di-n-octyl phthalate	0.072	0 - 6	-	5.49E+03	-	1.3E-05
Fluoranthene	0.34	0 - 6	-	1.10E+04	-	3.1E-05
Indeno(1,2,3-cd)pyrene	0.099	0 - 6	8.77E-01	-	1.1E-01	-
Methylene chloride	0.034	1 - 2	8.54E+01	1.65E+04	4.0E-04	2.1E-06
Pentachlorophenol	0.66	0 - 4	5.34E+00	8.23E+03	1.2E-01	8.0E-05
Phenanthrene	0.17	0 - 6	-	-	-	-
Pyrene	0.19	0 - 6	-	8.23E+03	-	2.3E-05
Toluene	1.1	1 - 2	-	5.49E+04	-	2.0E-05
Pesticides/PCBs (mg/kg)						
Aroclor-1254	0.425	0	8.32E-02	1.92E+01	5.1E+00	2.2E-02
Inorganics (mg/kg)						
Barium	373	6 - 12	-	1.92E+04	-	1.9E-02
Chromium	35.1	0	-	2.74E+05	-	1.3E-04
Lead	51.4	0	-	-	-	-
Nickel	20.9	0	-	5.49E+03	-	3.8E-03
Strontium	223	0 - 6	-	1.65E+05	-	1.4E-03
Vanadium	118	6 - 12	-	1.92E+03	-	6.1E-02
Zinc	117	0	-	8.23E+04	-	1.4E-03
Radionuclides² (pCi/g)						
Americium-241	3.24	0	2.37E+00	-	1.4E+00	-
Plutonium-239,240	15.22	0	3.42E+00	-	4.5E+00	-
Uranium-235	0.098	0	1.73E-01	-	5.7E-01	-
Uranium-238	1.6	6 - 12	4.60E+01	-	3.5E-02	-
Ratio Sum					1.4E+01	1.1E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-13
ROCKY FLATS OU6
RBC SCREEN FOR UPGRADIENT DRAINAGE (GW-4)
UHSU GROUNDWATER (UNFILTERED)

Analyte ¹	Maximum Concentration or Activity	Well ID	Residential Groundwater RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/l)						
Acetone	0 01	B208089	-	3 65E+00	-	2 7E-03
Benzene	0 003	B208089	6 15E-04	-	4 9E+00	-
Chloroform	0 0002	76292	2 76E-04	3 65E-01	7 2E-01	5 5E-04
Ethylbenzene	0 001	B208089	-	1 58E+00	-	6 3E-04
Methylene chloride	0 0002	76292	6 22E-03	1 73E+00	3 2E-02	1 2E-04
Tetrachloroethene	0 003	P209789	1 43E-03	3 65E-01	2 1E+00	8 2E-03
Toluene	0 016	B208089	-	9 65E-01	-	1 7E-02
Total xylenes	0 014	B208089	-	7 30E+01	-	1 9E-04
Trichloroethene	0 004	P209789	2 55E-03	-	1 6E+00	-
					9 3E+00	2 9E-02
Inorganics (mg/l)						
Aluminum	19 2	76292	-	-	-	-
Barium	0 39	76292	-	2 56E+00	-	1 5E-01
Lead	0 016	76292	-	-	-	-
Manganese	0 529	76292	-	1 82E-01	-	2 9E+00
Strontium	1 96	B208089	-	2 19E+01	-	8 9E-02
Nitrates	95	P209789	-	5 84E+01	-	1 6E+00
					-	4 8E+00
Radionuclides ² (pCi/l)						
Radium-226	1 2	76292	3 97E-01	-	3 0E+00	-
					3 0E+00	-
				Ratio Sum	1 2E+01	4 8E+00

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-14
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.1 (A-1)
POND SEDIMENTS

Analyte ¹	Maximum	Residential Soil RBCs		Ratio of Concentration to RBC	
	Concentration or Activity	Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
2-Butanone	0 013	-	1 65E+05	-	7 9E-08
Acenaphthene	0 089	-	1 65E+04	-	5 4E-06
Acetone	0 11	-	2 74E+04	-	4 0E-06
Anthracene	0 088	-	8 23E+04	-	1 1E-06
Benzo(a)anthracene	0 27	8 77E-01	-	3 1E-01	-
Benzo(a)pyrene	0 31	8 77E-02	-	3 5E+00	-
Benzo(b)fluoranthene	0 42	8 77E-01	-	4 8E-01	-
Benzo(g,h,i)perylene	0 21	-	-	-	-
Benzo(k)fluoranthene	0 2	8 77E+00	-	2 3E-02	-
Bis(2-ethylhexyl)phthalate	0 485	4 57E+01	5 49E+03	1 1E-02	8 8E-05
Butyl benzyl phthalate	0 12	-	5 49E+04	-	2 2E-06
Chrysene	0 35	8 77E+01	-	4 0E-03	-
Di-n-octyl phthalate	0 21	-	5 49E+04	-	3 8E-06
Fluoranthene	0 79	-	1 10E+04	-	7 2E-05
Indeno(1,2,3-cd)pyrene	0 2	8 77E-01	-	2 3E-01	-
4-Methyl-2-pentanone	0 006	-	1 37E+04	-	4 4E-07
Methylene chloride	0 09	8 54E+01	1 65E+04	1 1E-03	5 5E-06
Phenanthrene	0 52	-	-	-	-
Pyrene	0 71	-	8 23E+03	-	8 6E-05
Toluene	0 21	-	5 49E+04	-	3 8E-06
Pesticides/PCBs (mg/kg)					
Aroclor-1254	0 59	8 32E-02	1 92E+01	7 1E+00	3 1E-02
Inorganics (mg/kg)					
Zinc	110	-	8 23E+04	-	1 3E-03
Radionuclides ³ (pCi/g)					
Americium-241	13 23	2 37E+00	-	5 6E+00	-
Plutonium-239,240	36 2	3 42E+00	-	1 1E+01	-
Uranium-233,234	2 483	4 47E+01	-	5 6E-02	-
Uranium-238	2 142	4 60E+01	-	4 7E-02	-
Ratio Sum				2 8E+01	3 2E-02

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used

TABLE 5-15
ROCKY FLATS OU6
RBC SCREEN FOR PONDS A-1 THROUGH A-4
POND SURFACE WATER (UNFILTERED)

Analyte ¹	Maximum Concentration or Activity	Residential Swimming Surface Water RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/l)					
Di-n-butyl phthalate	0.002	-	2.81E+03	-	7.1E-07
Methylene chloride	0.002	2.73E+02	8.73E+00	7.3E-06	2.3E-04
Radionuclides ² (pCi/l)					
Uranium-233,234	3.688	2.29E+03	-	1.6E-03	-
Uranium-235	0.37	2.29E+03	-	1.6E-04	-
Uranium-238	4.475	2.29E+03	-	2.0E-03	-
Ratio Sum				3.7E-03	2.3E-04

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used

TABLE 5-16
ROCKY FLATS OU6
RBC SCREEN FOR NORTH WALNUT CREEK DRAINAGE (GW-2)
UHSU GROUNDWATER (UNFILTERED)

Analyte ¹	Maximum Concentration or Activity	Well ID	Residential Groundwater RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/l)						
Acetone	0 027	1386	-	3 65E+00	-	7 4E-03
Benzene	0 002	1186	6 15E-04	-	3 3E+00	-
1,2,4-Trimethylbenzene	0 0002	41091	-	-	-	-
2-Butanone	0 001	1786	-	2 47E+00	-	4 0E-04
Carbon disulfide	0 0004	1386	-	2 76E-02	-	1 4E-02
Chloroform	0 0002	41091	2 76E-04	3 65E-01	7 2E-01	5 5E-04
Ethylbenzene	0 001	1186	-	1 58E+00	-	6 3E-04
m-Xylene	0 0001	41091	-	-	-	-
Methylene chloride	0 002	41091	6 22E-03	1 73E+00	3 2E-01	1 2E-03
p-Xylene	0 0001	41091	-	-	-	-
4-Methyl-2-pentanone	0 002	1386	-	1 98E-01	-	1 0E-02
Styrene	0 00011	41091	-	2 01E+00	-	5 5E-05
Tetrachloroethene	0 002	1386	1 43E-03	3 65E-01	1 4E+00	5 5E-03
Toluene	0 016	1186	-	9 65E-01	-	1 7E-02
Trichloroethene	0 002	1786	2 55E-03	-	7 8E-01	-
Bis(2-ethylhexyl)phthalate	0 004	41091	6 07E-03	7 30E-01	6 6E-01	5 5E-03
Diethyl phthalate	0 002	41091	-	2 92E+01	-	6 8E-05
Xylenes, total	0 007	1186	-	7 30E+01	-	9 6E-05
					7 1E+00	6 2E-02
Inorganics (mg/l)						
Aluminum	196	1286	-	-	-	-
Antimony	0 179	B210489	-	1 46E-02	-	1 2E+01
Arsenic	0 018	1786	4 86E-05	1 09E-02	3 7E+02	1 7E+00
Barium	2 09	1286	-	2 56E+00	-	8 2E-01
Beryllium	0 0149	1286	1 98E-05	1 82E-01	7 5E+02	8 2E-02
Cadmium	0 0329	1786	-	1 82E-02	-	1 8E+00
Chromium	0 216	1286	-	3 65E+01	-	5 9E-03
Cobalt	0 111	1286	-	-	-	-
Copper	0 314	1286	-	1 46E+00	-	2 2E-01
Lead	0 254	1286	-	-	-	-
Lithium	0 456	1786	-	-	-	-
Manganese	3 32	1286	-	1 82E-01	-	1 8E+01
Mercury	0 0014	1786	-	1 09E-02	-	1 3E-01
Nickel	0 264	1286	-	7 30E-01	-	3 6E-01
Selenium	0 475	B210489	-	1 82E-01	-	2 6E+00
Silver	0 0392	1786	-	1 82E-01	-	2 2E-01
Strontium	6 96	1786	-	2 19E+01	-	3 2E-01
Vanadium	0 464	1286	-	2 56E-01	-	1 8E+00
Zinc	1 53	1286	-	1 09E+01	-	1 4E-01
Nitrates	704	1786	-	5 84E+01	-	1 2E+01
					1 1E+03	5 3E+01

TABLE 5-16
(concluded)

Analyte	Maximum Concentration or Activity	Well ID	Residential Groundwater RBCs		Ratio of Concentration to RBC	
			Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Radionuclides² (pCi/l)						
Americium-241	1 087	1286	1 98E-01	-	5 5E+00	-
Cesium-137	4 499	1286	1 70E+00	-	2 6E+00	-
Plutonium-239,240	3 65	1286	2 07E-01	-	1 8E+01	-
Radium-226	0 72	1186	3 97E-01	-	1 8E+00	-
					2 8E+01	-
Cumulative Ratio					1 2E+03	5 3E+01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-17
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.2 (A-2)
POND SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
2-Butanone	0.026	-	1.65E+05	-	1.6E-07
Acetone	3.3	-	2.74E+04	-	1.2E-04
Benzo(a)anthracene	0.058	8.77E-01	-	6.6E-02	-
Benzo(a)pyrene	0.075	8.77E-02	-	8.6E-01	-
Benzoic acid	0.33	-	1.10E+06	-	3.0E-07
Bis(2-ethylhexyl)phthalate	7.8	4.57E+01	5.49E+03	1.7E-01	1.4E-03
Chrysene	0.071	8.77E+01	-	8.1E-04	-
Fluoranthene	0.16	-	1.10E+04	-	1.5E-05
Methylene chloride	8.3	8.54E+01	1.65E+04	9.7E-02	5.0E-04
Phenanthrene	0.12	-	-	-	-
Pyrene	0.13	-	8.23E+03	-	1.6E-05
Toluene	0.86	-	5.49E+04	-	1.6E-05
Pesticides/PCBs (mg/kg)					
Aldrin	0.054	3.77E-02	8.23E+00	1.4E+00	6.6E-03
Aroclor-1254	0.59	8.32E-02	1.92E+01	7.1E+00	3.1E-02
Inorganics (mg/kg)					
Zinc	409	-	8.23E+04	-	5.0E-03
Radionuclides² (pCi/g)					
Americium-241	1.74	2.37E+00	-	7.3E-01	-
Plutonium-239,240	5.65	3.42E+00	-	1.7E+00	-
Uranium-233,234	1.83	4.47E+01	-	4.1E-02	-
Uranium-238	2.55	4.60E+01	-	5.5E-02	-
Ratio Sum				1.2E+01	4.4E-02

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-18
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.3 (A-3)
POND SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
2-Butanone	0 004	-	1 65E+05	-	2 4E-08
Acetone	0 063	-	2 74E+04	-	2 3E-06
Benzo(a)pyrene	0 24	8 77E-02	-	2 7E+00	-
Benzo(b)fluoranthene	0 37	8 77E-01	-	4 2E-01	-
Bis(2-ethylhexyl)phthalate	0 99	4 57E+01	5 49E+03	2 2E-02	1 8E-04
Chrysene	0 25	8 77E+01	-	2 9E-03	-
Fluoranthene	0 54	-	1 10E+04	-	4 9E-05
Methylene chloride	0 009	8 54E+01	1 65E+04	1 1E-04	5 5E-07
Phenanthrene	0 26	-	-	-	-
Pyrene	0 46	-	8 23E+03	-	5 6E-05
Toluene	0 062	-	5 49E+04	-	1 1E-06
Inorganics (mg/kg)					
Chromium	29 9	-	2 74E+05	-	1 1E-04
Vanadium	62 7	-	1 92E+03	-	3 3E-02
Zinc	155	-	8 23E+04	-	1 9E-03
Radionuclides ² (pCi/g)					
Uranium-233,234	1 592	4 47E+01	-	3 6E-02	-
Ratio Sum				3 2E+00	3 5E-02

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used

TABLE 5-19
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.4 (A-4)
POND SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
Acetone	0.046	-	2.74E+04	-	1.7E-06
Benzene	0.003	2.21E+01	-	1.4E-04	-
Bis(2-ethylhexyl)phthalate	0.95	4.57E+01	5.49E+03	2.1E-02	1.7E-04
Methylene chloride	0.017	8.54E+01	1.65E+04	2.0E-04	1.0E-06
Toluene	0.008	-	5.49E+04	-	1.5E-07
Inorganics (mg/kg)					
Antimony	41.4	-	1.10E+02	-	3.8E-01
Chromium	23.8	-	2.74E+05	-	8.7E-05
Vanadium	57.7	-	1.92E+03	-	3.0E-02
Zinc	169	-	8.23E+04	-	2.1E-03
Radionuclides ² (pCi/g)					
Strontium-89,90	1.8	2.40E+01	-	7.5E-02	-
Uranium-233,234	1.68	4.47E+01	-	3.8E-02	-
Uranium-238	1.67	4.60E+01	-	3.6E-02	-
Ratio Sum				1.7E-01	4.1E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-20
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.5 (B-1)
POND SEDIMENTS

Analyte ¹	Maximum	Residential Soil RBCs		Ratio of Concentration to RBC	
	Concentration or Activity	Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
2-Butanone	0 021	-	1 65E+05	-	1 3E-07
Acenaphthene	0 315	-	1 65E+04	-	1 9E-05
Acetone	0 39	-	2 74E+04	-	1 4E-05
Anthracene	0 38	-	8 23E+04	-	4 6E-06
Benzo(a)anthracene	1 1	8 77E-01	-	1 3E+00	-
Benzo(a)pyrene	0 87	8 77E-02	-	9 9E+00	-
Benzo(b)fluoranthene	3 1	8 77E-01	-	3 5E+00	-
Benzo(k)fluoranthene	1	8 77E+00	-	1 1E-01	-
Benzoic acid	4 6	-	1 10E+06	-	4 2E-06
Bis(2-ethylhexyl)phthalate	88	4 57E+01	5 49E+03	1 9E+00	1 6E-02
Chrysene	1 9	8 77E+01	-	2 2E-02	-
Dibenzo(a,h)anthracene	0 15	8 77E-02	-	1 7E+00	-
Dibenzofuran	0 18	-	-	-	-
Fluoranthene	3 5	-	1 10E+04	-	3 2E-04
Fluorene	0 46	-	1 10E+04	-	4 2E-05
Indeno(1,2,3-cd)pyrene	0 36	8 77E-01	-	4 1E-01	-
Methylene chloride	0 015	8 54E+01	1 65E+04	1 8E-04	9 1E-07
2-Methylnaphthalene	0 17	-	-	-	-
Naphthalene	0 39	-	1 10E+04	-	3 5E-05
Phenanthrene	2 6	-	-	-	-
Phenol	0 29	-	1 65E+05	-	1 8E-06
Pyrene	3 8	-	8 23E+03	-	4 6E-04
1,2,3-Trichlorobenzene	0 13	-	-	-	-
Toluene	1 1	-	5 49E+04	-	2 0E-05
Pesticides/PCBs (mg/kg)					
Aroclor-1254	10	8 32E-02	1 92E+01	1 2E+02	5 2E-01
Heptachlor	0 039	1 42E-01	1 37E+02	2 7E-01	2 8E-04
Inorganics (mg/kg)					
Chromium	96 1	-	2 74E+05	-	3 5E-04
Copper	125	-	1 10E+04	-	1 1E-02
Silver	345	-	1 37E+03	-	2 5E-01
Zinc	1270	-	8 23E+04	-	1 5E-02

TABLE 5-20
(concluded)

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Radionuclides ² (pCi/g)					
Americium-241	389 4	2 37E+00	-	1 6E+02	-
Plutonium-239,240	92	3 42E+00	-	2 7E+01	-
Uranium-233,234	25 22	4 47E+01	-	5 6E-01	-
Uranium-235	1 302	1 73E-01	-	7 5E+00	-
Uranium-238	43 09	4 60E+01	-	9 4E-01	-
Ratio Sum				3 4E+02	8 2E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used

TABLE 5-21
ROCKY FLATS OU6
RBC SCREEN FOR PONDS B-1 THROUGH B-5
POND SURFACE WATER (UNFILTERED)

Analyte ¹	Maximum Concentration or Activity	Residential Swimming Surface Water RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
1,2-Dichloroethane	0.001	7.20E-01	-	1.4E-03	-
1,2-Dichloroethene	0.003	2.53E+02	-	1.2E-05	-
Acetone	0.02	-	2.81E+03	-	7.1E-06
Chloroform	0.002	1.07E+01	2.81E+02	1.9E-04	7.1E-06
Di-n-butyl phthalate	0.001	-	2.81E+03	-	3.6E-07
Methylene chloride	0.034	8.73E+00	1.68E+03	3.9E-03	2.0E-05
Tetrachloroethene	0.012	1.26E+00	2.81E+02	9.5E-03	4.3E-05
Trichloroethene	0.006	5.95E+00	-	1.0E-03	-
Radionuclides² (pCi/g)					
Uranium-233,234	3.569	2.29E+03	-	1.6E-03	-
Uranium-235	0.56	2.29E+03	-	2.4E-04	-
Uranium-238	3.198	2.29E+03	-	1.4E-03	-
Ratio Sum				1.8E-02	7.8E-05

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-22
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.6 (B-2)
POND SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
2-Butanone	0.13	-	1.65E+05	-	7.9E-07
Acetone	0.81	-	2.74E+04	-	3.0E-05
Benzo(a)anthracene	0.12	8.77E-01	-	1.4E-01	-
Benzo(a)pyrene	0.13	8.77E-02	-	1.5E+00	-
Benzo(k)fluoranthene	0.062	8.77E+00	-	7.1E-03	-
Benzoic acid	3.9	-	1.10E+06	-	3.5E-06
Bis(2-ethylhexyl)phthalate	9	4.57E+01	5.49E+03	2.0E-01	1.6E-03
Chrysene	0.2	8.77E+01	-	2.3E-03	-
Fluoranthene	0.4	-	1.10E+04	-	3.6E-05
Phenanthrene	0.27	-	-	-	-
Pyrene	0.33	-	8.23E+03	-	4.0E-05
Toluene	0.13	-	5.49E+04	-	2.4E-06
Pesticides/PCBs (mg/kg)					
Aroclor-1254	6.6	8.32E-02	1.92E+01	7.9E+01	3.4E-01
Inorganics (mg/kg)					
Silver	207	-	1.37E+03	-	1.5E-01
Zinc	140	-	8.23E+04	-	1.7E-03
Radionuclides² (pCi/g)					
Americium-241	23.1	2.37E+00	-	9.7E+00	-
Plutonium-239,240	41.2	3.42E+00	-	1.2E+01	-
Uranium-233,234	9.56	4.47E+01	-	2.1E-01	-
Uranium-235	0.306	1.73E-01	-	1.8E+00	-
Uranium-238	7.42	4.60E+01	-	1.6E-01	-
Ratio Sum				1.1E+02	5.0E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-23
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.7 (B-3)
POND SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
2-Butanone	0 022	-	1 65E+05	-	1 3E-07
Acetone	0 14	-	2 74E+04	-	5 1E-06
Anthracene	0 8	-	8 23E+04	-	9 7E-06
Benzo(a)anthracene	0 17	8 77E-01	-	1 9E-01	-
Benzo(a)pyrene	0 26	8 77E-02	-	3 0E+00	-
Benzo(b)fluoranthene	0 77	8 77E-01	-	8 8E-01	-
Bis(2-ethylhexyl)phthalate	9 1	4 57E+01	5 49E+03	2 0E-01	1 7E-03
Chrysene	0 51	8 77E+01	-	5 8E-03	-
Fluoranthene	1 2	-	1 10E+04	-	1 1E-04
Methylene chloride	0 03	8 54E+01	1 65E+04	3 5E-04	1 8E-06
Phenanthrene	0 65	-	-	-	-
Pyrene	1 2	-	8 23E+03	-	1 5E-04
Toluene	0 67	-	5 49E+04	-	1 2E-05
Pesticides/PCBs (mg/kg)					
Aroclor-1254	2 9	8 32E-02	1 92E+01	3 5E+01	1 5E-01
Aroclor-1260	0 86	8 32E-02	1 92E+01	1 0E+01	4 5E-02
Inorganics (mg/kg)					
Antimony	68 5	-	1 10E+02	-	6 2E-01
Chromium	37 8	-	2 74E+05	-	1 4E-04
Silver	240	-	1 37E+03	-	1 8E-01
Zinc	346	-	8 23E+04	-	4 2E-03
Radionuclides ² (pCi/g)					
Americium-241	63 07	2 37E+00	-	2 7E+01	-
Plutonium-239,240	180 2	3 42E+00	-	5 3E+01	-
Uranium-233,234	7 843	4 47E+01	-	1 8E-01	-
Uranium-235	0 4774	1 73E-01	-	2 8E+00	-
Uranium-238	12 41	4 60E+01	-	2 7E-01	-
Ratio Sum				1 3E+02	1 0E+00

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-24
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.8 (B-4)
POND SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
2-Butanone	0 011	-	1 65E+05	-	6 7E-08
Acenaphthene	0 59	-	1 65E+04	-	3 6E-05
Acetone	0 068	-	2 74E+04	-	2 5E-06
Anthracene	0 1	-	8 23E+04	-	1 2E-06
Benzo(a)anthracene	0 43	8 77E-01	-	4 9E-01	-
Benzo(a)pyrene	0 57	8 77E-02	-	6 5E+00	-
Benzo(b)fluoranthene	1 5	8 77E-01	-	1 7E+00	-
Benzo(g,h,i)perylene	0 36	-	-	-	-
Benzo(k)fluoranthene	0 36	8 77E+00	-	4 1E-02	-
Benzene	0 01	2 21E+01	-	4 5E-04	-
Bis(2-ethylhexyl)phthalate	5	4 57E+01	5 49E+03	1 1E-01	9 1E-04
Butyl benzyl phthalate	0 101	-	5 49E+04	-	1 8E-06
Chrysene	0 65	8 77E+01	-	7 4E-03	-
Di-n-octyl phthalate	0 25	-	5 49E+03	-	4 6E-05
Fluoranthene	1 4	-	1 10E+04	-	1 3E-04
Indeno(1,2,3-cd)pyrene	0 66	8 77E-01	-	7 5E-01	-
Methylene chloride	0 01	8 54E+01	1 65E+04	1 2E-04	6 1E-07
Phenanthrene	0 76	-	-	-	-
Pyrene	1 2	-	8 23E+03	-	1 5E-04
Toluene	0 36	-	5 49E+04	-	6 6E-06
Pesticides/PCBs (mg/kg)					
Aroclor-1254	1 1	8 32E-02	1 92E+01	1 3E+01	5 7E-02
Gamma-BHC (Lindane)	0 025	4 93E-01	8 23E+01	5 1E-02	3 0E-04
Inorganics (mg/kg)					
Chromium	26 1	-	2 74E+05	-	9 5E-05
Silver	102	-	1 37E+03	-	7 4E-02
Zinc	319	-	8 23E+04	-	3 9E-03
Radionuclides ² (pCi/g)					
Americium-241	7 452	2 37E+00	-	3 1E+00	-
Plutonium-239,240	24 09	3 42E+00	-	7 0E+00	-
Uranium-233,234	2 183	4 47E+01	-	4 9E-02	-
Uranium-235	0 143	1 73E-01	-	8 3E-01	-
Uranium-238	2 749	4 60E+01	-	6 0E-02	-
Ratio Sum				3 4E+01	1 4E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-25
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.9 (B-5)
POND SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	<u>Residential Soil RBCs</u>		<u>Ratio of Concentration to RBC</u>	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
2-Butanone	0 021	-	1 65E+05	-	1 3E-07
Acetone	0 087	-	2 74E+04	-	3 2E-06
Benzene	0 004	2 21E+01	-	1 8E-04	-
Bis(2-ethylhexyl)phthalate	1 1	4 57E+01	5 49E+03	2 4E-02	2 0E-04
Di-n-octyl phthalate	0 24	-	5 49E+03	-	4 4E-05
Fluoranthene	0 19	-	1 10E+04	-	1 7E-05
Methylene chloride	0 012	8 54E+01	1 65E+04	1 4E-04	7 3E-07
Pyrene	0 16	-	8 23E+03	-	1 9E-05
Toluene	0 047	-	5 49E+04	-	8 6E-07
Inorganics (mg/kg)					
Chromium	21 4	-	2 74E+05	-	7 8E-05
Zinc	174	-	8 23E+04	-	2 1E-03
Radionuclides² (pCi/g)					
Radium-228	1 835	7 93E+00	-	2 3E-01	-
Ratio Sum				2 6E-01	2 5E-03

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-26
ROCKY FLATS OU6
RBC SCREEN FOR IHSS 142.12 (WALNUT AND INDIANA POND)
POND SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
2-Butanone	0.051	-	1.65E+05	-	3.1E-07
Acetone	0.21	-	2.74E+04	-	7.7E-06
Benzoic acid	0.5	-	1.10E+06	-	4.5E-07
Bis(2-ethylhexyl)phthalate	0.13	4.57E+01	5.49E+03	2.8E-03	2.4E-05
Methylene chloride	0.02	8.54E+01	1.65E+04	2.3E-04	1.2E-06
Phenol	0.11	-	1.65E+05	-	6.7E-07
Toluene	0.018	-	5.49E+04	-	3.3E-07
Ratio Sum				3.1E-03	3.4E-05

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

TABLE 5-27
ROCKY FLATS OU6
RBC SCREEN FOR WALNUT AND INDIANA POND
SURFACE WATER (UNFILTERED)

Analyte¹	Maximum Concentration or Activity	Residential Swimming Surface Water RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
Acetone	0.14	-	2.81E+03	-	5.0E-05
			Ratio Sum	-	5.0E-05

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

TABLE 5-28
ROCKY FLATS OU6
RBC SCREEN FOR WALNUT AND INDIANA DRAINAGE (GW-5)
UHSU GROUNDWATER (UNFILTERED)

Analyte ¹	Maximum Concentration or Activity	Well ID	Residential		Ratio of Concentration to RBC	
			Groundwater RBCs		Carcinogen	Noncarcinogen
			Carcinogen	Noncarcinogen		
Organics (mg/l)						
Methylene chloride	0.01	0486	6.22E-03	1.73E+00	1.6E+00	5.8E-03
Toluene	0.00013	41691	-	9.65E-01	-	1.3E-04
Bis(2-ethylhexyl)phthalate	0.003	0486	6.07E-03	7.30E-01	4.9E-01	4.1E-03
					2.1E+00	1.0E-02
Inorganics (mg/l)						
Aluminum	117	41691	-	-	-	-
Antimony	0.194	41691	-	1.46E-02	-	1.3E+01
Arsenic	0.008	0486	4.86E-05	1.09E-02	1.6E+02	7.3E-01
Barium	1.32	41691	-	2.56E+00	-	5.2E-01
Beryllium	0.0089	41691	1.98E-05	1.82E-01	4.5E+02	4.9E-02
Cadmium	0.0062	41691	-	1.82E-02	-	3.4E-01
Chromium	0.247	0486	-	3.65E+01	-	6.8E-03
Cobalt	0.0811	41691	-	-	-	-
Copper	0.189	41691	-	1.46E+00	-	1.3E-01
Lead	0.0966	41691	-	-	-	-
Manganese	3.19	0486	-	1.82E-01	-	1.8E+01
Mercury	0.00072	41691	-	1.09E-02	-	6.6E-02
Nickel	0.199	41691	-	7.30E-01	-	2.7E-01
Silver	0.0103	41691	-	1.82E-01	-	5.7E-02
Strontium	0.931	41691	-	2.19E+01	-	4.3E-02
Vanadium	0.312	41691	-	2.56E-01	-	1.2E+00
Zinc	0.665	41691	-	1.09E+01	-	6.1E-02
					6.1E+02	3.4E+01
Radionuclides² (pCi/l)						
Americium-241	3.2	41691	1.98E-01	-	1.6E+01	-
Plutonium-239,240	2.204	41691	2.07E-01	-	1.1E+01	-
Radium-226	1.1	41691	3.97E-01	-	2.8E+00	-
Strontium-89,90	1.044	0486	1.44E+00	-	7.3E-01	-
					3.0E+01	-
Ratio Sum					6.5E+02	3.4E+01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-29
ROCKY FLATS OU6
RBC SCREEN FOR NORTH WALNUT CREEK DRAINAGE
STREAM SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
Acetone	0.063	-	2.74E+04	-	2.3E-06
Benzo(a)pyrene	0.11	8.77E-02	-	1.3E+00	-
Benzo(b)fluoranthene	0.14	8.77E-01	-	1.6E-01	-
Benzoic acid	0.51	-	1.10E+06	-	4.6E-07
Bis(2-ethylhexyl)phthalate	0.19	4.57E+01	5.49E+03	4.2E-03	3.5E-05
Chrysene	0.1	8.77E+01	-	1.1E-03	-
Fluoranthene	0.18	-	1.10E+04	-	1.6E-05
Methylene chloride	0.007	8.54E+01	1.65E+04	8.2E-05	4.2E-07
Phenanthrene	0.11	-	-	-	-
Pyrene	0.16	-	8.23E+03	-	1.9E-05
Inorganics (mg/kg)					
Manganese	1000	-	1.37E+03	-	7.3E-01
Ratio Sum				1.4E+00	7.3E-01

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

TABLE 5-30
ROCKY FLATS OU6
RBC SCREEN FOR SOUTH WALNUT CREEK DRAINAGE
STREAM SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
Acenaphthene	0.13	-	1.65E+04	-	7.9E-06
Anthracene	0.15	-	8.23E+04	-	1.8E-06
Benzo(a)anthracene	0.43	8.77E-01	-	4.9E-01	-
Benzo(a)pyrene	0.48	8.77E-02	-	5.5E+00	-
Benzo(b)fluoranthene	0.65	8.77E-01	-	7.4E-01	-
Benzo(g,h,i)perylene	0.16	-	-	-	-
Benzo(k)fluoranthene	0.23	8.77E+00	-	2.6E-02	-
Benzoic acid	0.11	-	1.10E+06	-	1.0E-07
Chrysene	0.51	8.77E+01	-	5.8E-03	-
Dibenzofuran	0.037	-	-	-	-
Di-n-butyl phthalate	0.068	-	2.74E+04	-	2.5E-06
Fluoranthene	1.0	-	1.10E+04	-	9.1E-05
Fluorene	0.089	-	1.10E+04	-	8.1E-06
Indeno(1,2,3-cd)pyrene	0.18	8.77E-01	-	2.1E-01	-
Naphthalene	0.046	-	1.10E+04	-	4.2E-06
Phenanthrene	0.75	-	-	-	-
Pyrene	0.96	-	8.23E+03	-	1.2E-04
Ratio Sum				6.9E+00	2.3E-04

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

TABLE 5-31
ROCKY FLATS OU6
RBC SCREEN FOR WALNUT AND INDIANA EFFLUENT
STREAM SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
Benzoic acid	0.17	-	1.10E+06	-	1.5E-07
Benzyl alcohol	0.041	-	8.23E+04	-	5.0E-07
Bis(2-ethylhexyl)phthalate	0.17	4.57E+01	5.49E+03	3.7E-03	3.1E-05
Di-n-butyl phthalate	0.045	-	2.74E+04	-	1.6E-06
Ratio Sum				3.7E-03	3.3E-05

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

TABLE 5-32
ROCKY FLATS OU6
RBC SCREEN FOR UPGRADIENT OF OU6
STREAM SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
Anthracene	0 065	-	1 65E+04	-	3 9E-06
Benzo(a)anthracene	0 17	8 77E-01	-	1 9E-01	-
Benzo(a)pyrene	0 2	8 77E-02	-	2 3E+00	-
Benzo(b)fluoranthene	0 2	8 77E-01	-	2 3E-01	-
Benzo(k)fluoranthene	0 074	8 77E+00	-	8 4E-03	-
Benzoic acid	0 13	-	1 10E+06	-	1 2E-07
Butyl benzyl phthalate	0 12	-	5 49E+04	-	2 2E-06
Chrysene	0 18	8 77E+01	-	2 1E-03	-
Di-n-butyl phthalate	0 075	-	2 74E+04	-	2 7E-06
Fluoranthene	0 38	-	1 10E+04	-	3 5E-05
Indeno(1,2,3-cd)pyrene	0 066	8 77E-01	-	7 5E-02	-
Phenanthrene	0 26	-	-	-	-
Pyrene	0 35	-	8 23E+03	-	4 3E-05
Ratio Sum				2 8E+00	8 2E-05

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

TABLE 5-33
ROCKY FLATS OU6
RBC SCREEN FOR NORTH WALNUT CREEK (A-SERIES PONDS)
DRY SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Surficial Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
Benzo(a)anthracene	0 19	8 77E-01	-	2 2E-01	-
Benzo(a)pyrene	0 26	8 77E-02	-	3 0E+00	-
Benzo(b)fluoranthene	0 4	8 77E-01	-	4 6E-01	-
Benzo(ghi)perylene	0 11	-	-	-	-
Benzo(k)fluoranthene	0 17	8 77E+00	-	1 9E-02	-
Bis(2-ethylhexyl)phthalate	0 35	4 57E+01	5 49E+03	7 7E-03	6 4E-05
Chrysene	0 23	8 77E+01	-	2 6E-03	-
Fluoranthene	0 56	-	1 10E+04	-	5 1E-05
Indeno(1,2,3-cd)pyrene	0 11	8 77E-01	-	1 3E-01	-
Phenanthrene	0 29	-	-	-	-
Pyrene	0 37	-	8 23E+03	-	4 5E-05
Pesticides/PCBs (mg/kg)					
delta-BHC	0 013	-	-	-	-
Inorganics (mg/kg)					
Copper	22 8	-	1 10E+04	-	2 1E-03
Mercury	0 18	-	8 23E+01	-	2 2E-03
Nickel	25 2	-	5 49E+03	-	4 6E-03
Strontium	69 7	-	1 65E+05	-	4 2E-04
Zinc	293	-	8 23E+04	-	3 6E-03
Radionuclides² (pCi/g)					
Americium-241	0 43725	2 37E+00	-	1 8E-01	-
Plutonium-239,240	4 444	3 42E+00	-	1 3E+00	-
Ratio Sum				5 3E+00	1 3E-02

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

TABLE 5-34
ROCKY FLATS OU6
RBC SCREEN FOR SOUTH WALNUT CREEK (B-SERIES PONDS)
DRY SEDIMENTS

Analyte ¹	Maximum Concentration or Activity	Residential Soil RBCs		Ratio of Concentration to RBC	
		Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Organics (mg/kg)					
Acenaphthene	0 1215	-	1 65E+04	-	7 4E-06
Anthracene	0 17	-	8 23E+04	-	2 1E-06
Benzo(a)anthracene	0 28	8 77E-01	-	3 2E-01	-
Benzo(a)pyrene	0 38	8 77E-02	-	4 3E+00	-
Benzo(b)fluoranthene	0 5	8 77E-01	-	5 7E-01	-
Benzo(ghi)perylene	0 15	-	-	-	-
Benzo(k)fluoranthene	0 18	8 77E+00	-	2 1E-02	-
Chrysene	0 35	8 77E+01	-	4 0E-03	-
Diethyl phthalate	0 46	-	2 20E+05	-	2 1E-06
Fluoranthene	0 9	-	1 10E+04	-	8 2E-05
Fluorene	0 08	-	1 10E+04	-	7 3E-06
Indeno(1,2,3-cd)pyrene	0 19	8 77E-01	-	2 2E-01	-
Naphthalene	0 12	-	1 10E+04	-	1 1E-05
Phenanthrene	0 72	-	-	-	-
Pyrene	0 61	-	8 23E+03	-	7 4E-05
Inorganics (mg/kg)					
Nickel	26 4	-	5 49E+03	-	4 8E-03
Strontium	92 4	-	1 65E+05	-	5 6E-04
Zinc	286	-	8 23E+04	-	3 5E-03
Radionuclides² (pCi/g)					
Americium-241	1 293	2 37E+00	-	5 5E-01	-
Plutonium-239,240	3 095	3 42E+00	-	9 0E-01	-
Cumulative Ratio				6 9E+00	9 0E-03

¹ Only metals and radionuclides with concentrations or activities greater than background mean plus 2 standard deviations are listed.

² For radionuclides listed with more than one isotope, the more conservative RBC was used.

CDPHE CONSERVATIVE SCREENING DECISION CRITERIA

The results of the risk-based screen are compared to decision criteria to help identify an appropriate course of action for each medium in each source area. The decision criteria are as follows

- If the ratio sum ≥ 100 , a voluntary corrective action (or early action) may be initiated or a baseline HHRA will be performed
- If $1 < \text{ratio sum} < 100$, a baseline HHRA must be conducted
- If ratio sum ≤ 1 , no further action may be required pending evaluation of applicable or relevant and appropriate regulations (ARARs) or potential risk from dermal exposure

6.1 DERMAL EXPOSURE EVALUATION

In cases where the ratio sum is less than 1 for a source area, the potential risk from dermal contact with soil or sediment was evaluated to ensure that cumulative risk, including dermal exposure, would not exceed a level of concern (ratio sum > 1). RBCs for dermal contact with soil or sediment were calculated assuming residential exposure. The RBCs for carcinogens were calculated assuming a target excess lifetime cancer risk of 10^{-6} , exposed skin surface area (SA) of $2,910 \text{ cm}^2$ (approximately equivalent to hands, face, and forearms), absorption factors (AB) of 0.001 for metals and 0.01 for organics, a soil adherence factor of 0.5 mg/cm^2 , an exposure frequency (EF) of 350 days/year, exposure duration (ED) of 30 years, body weight (BW) of 70 kg, and averaging time (AT) of 25,550 days (70 years) and a unit conversion factor (CF) of 10^{-6} kg/mg . In calculating RBCs for noncarcinogenic effects, all of the exposure parameters are the same except the averaging time is 10,950 days (30 years) and the target hazard index of 1 replaces the target excess lifetime cancer risk. The intake factor equation for dermal contact is

$$IF = \frac{(SA) (AB) (AF) (EF) (ED) (CF)}{(BW) (AT)}$$

The dermal evaluation is performed only for those organic chemicals and metals that contribute most significantly to the carcinogenic and noncarcinogenic total ratios calculated in Section 5.0. If the carcinogenic and noncarcinogenic ratios for dermal contact with chemicals in soil and sediment are less than 1 and when added to the ratios for other soil and sediment exposures do not result in a ratio sum greater than 1, the source area is a candidate for no further action pending an ARARs review. If either the carcinogenic or noncarcinogenic ratio for dermal contact to chemicals in soil or sediment is greater than 1, or when added to the ratios for other soil or sediment exposures result in a ratio sum greater than 1, the source area will be retained for further evaluation.

Quantification of risk from dermal contact with carcinogenic PAHs in soil is considered inappropriate because of the uncertainties associated with estimating carcinogenicity for chemicals that can cause cancer at the point of contact (EPA 1989). Therefore, PAHs were not included in the evaluation of dermal exposure. Dermal absorption of radionuclides is also not quantified because "dermal uptake is generally not an important route of uptake for radionuclides, which have small dermal permeability constants" (EPA 1989).

Six source areas had ratio sums < 1 for soil or sediment and either no other significantly contaminated media associated with them, or contaminated groundwater that will be addressed separately. These source areas require a dermal exposure evaluation before they may be considered candidates for no further action. The dermal exposure evaluation for IHSSs 166 1-3, IHSS 167 3, IHSS 142 4, IHSS 142 9, IHSS 142 12, and IHSS 216 1 is shown on Table 6-1. The dermal exposure evaluation demonstrates that the risk from dermal exposure is insignificant and that these IHSSs may be candidates for no further action.

6.2 APPLICATION OF DECISION CRITERIA TO SOURCE AREAS

Each source area was classified as a candidate for no further action or for further evaluation based on the results of the CDPHE conservative screen. The rationale for the classifications of the source areas is described in the following sections.

6.2.1 Candidates for No Further Action

The following IHSS is a candidate for no further action based on negligible soil contamination (ratio sum < 1) Risk from dermal exposure was found to be insignificant No groundwater is associated with this IHSS

IHSS 216 1

East Spray Field

The IHSSs listed below had negligible soil or sediment contamination (soil or sediment ratio sums were < 1) and risk from dermal exposure was found to be insignificant Furthermore, the IHSSs are not considered sources of contamination to groundwater because (1) soil or sediment contaminant levels are so low that measurable impacts on groundwater are unlikely, (2) other sources of groundwater contamination are evident or suspected, or (3) maximum concentrations of PCOCs in the groundwater area under evaluation were observed at sampling locations remote from the IHSS and there is no evidence of contaminant migration to the IHSS Therefore, these IHSSs are candidates for no further action based on negligible soil or sediment contamination and absence of IHSS-related groundwater contamination Groundwater is expected to be addressed through other mechanisms, as indicated below

IHSSs 166 1-3

Trenches

Address groundwater in OU7

Former IHSS 167 3

South Spray Field

Address groundwater in OU7

IHSS 142 4

Pond A-4

Address area 2 groundwater contamination with the other A-series ponds being evaluated in the baseline HHRA

IHSS 142 9

Pond B-5

Address area 3 groundwater contamination with the other B-series ponds being evaluated in the baseline HHRA

IHSS 142 12

**Walnut and
Indiana Pond**

Address potential groundwater contamination at Indiana Street wells in the RFI/RI report

6.2.2 Source Areas for Further Evaluation

The following IHSSs will be evaluated further in the baseline HHRA because the ratio sums for soil or sediment exceeded 1, assuming long-term residential exposure to maximum detected concentrations in soil or sediment at the IHSS. The ratio sums for groundwater also exceeded 1 (and in most cases exceeded 100), but these IHSSs are probably not the source of groundwater contamination. Nevertheless, groundwater exposure will be included in the baseline HHRA. No groundwater is associated with IHSSs 156 2 and 167 1.

IHSS 141	Sludge Dispersal Area
IHSSs 142 1, 142 2, and 142 3	Ponds A-1, A-2, and A-3
IHSSs 142 5, 142 6, 142 7, and 142 8	Ponds B-1 through B-4
IHSS 156 2	Soil Dump Area
IHSS 165	Triangle Area
IHSS 167 1	North Spray Field

6.2.3 Transfer to OU8

IHSS 143, the Old Outfall, is located in the industrialized portion of the plant, remote from other OU6 IHSSs, which are located outside the protected area and in the buffer zone. Because of its location, IHSS 143 is proposed for transfer to OU8, which includes IHSSs in the industrialized area.

TABLE 6-1
ROCKY FLATS OU6
DERMAL EXPOSURE RATIOS
LOW HAZARD IHSS₁

Analyte ⁽¹⁾	Maximum Concentration (mg/kg)	Oral		Cardiogenic		Noncardiogenic		Residential Dermal RBCs (mg/kg) ⁽²⁾		Ratio of Concentration to RBC	
		Slope Factor ⁽³⁾	Oral RfD ⁽³⁾	Intake Factor ⁽³⁾	Intake Factor ⁽³⁾	Factor ⁽³⁾	Factor ⁽³⁾	Cardiogenic	Noncardiogenic	Cardiogenic	Noncardiogenic
IHSSs 166.1, 166.2, and 166.3											
Methylene chloride	37	7.50E-03	6.00E-02	8.54E-08	2.80E-07	2.80E-08	2.80E-08	1.56E+03	2.14E+05	2.37E-03	1.73E-05
Barium	2970	-	7.00E-02	8.54E-09	2.80E-08	2.80E-08	2.80E-08	-	2.50E+06	-	1.19E-03
IHSS 167.3											
Strontium	341	-	6.00E-01	8.54E-09	2.80E-08	2.80E-08	2.80E-08	-	2.14E+07	-	1.59E-05
Zinc	119	-	3.00E-01	8.54E-09	2.80E-08	2.80E-08	2.80E-08	-	1.07E+07	-	1.11E-05
IHSS 142.4											
Bis(2-ethylhexyl)phthalate	0.95	1.40E-02	2.00E-02	8.54E-08	2.80E-07	2.80E-08	2.80E-08	8.36E+02	7.14E+04	1.14E-03	1.33E-05
Antimony	41.4	-	4.00E-04	8.54E-09	2.80E-08	2.80E-08	2.80E-08	-	1.43E+04	-	2.90E-03
Vanadium	57.7	-	7.00E-03	8.54E-09	2.80E-08	2.80E-08	2.80E-08	-	2.50E+05	-	2.31E-04
IHSS 142.9											
Bis(2-ethylhexyl)phthalate	1.1	1.40E-02	2.00E-02	8.54E-08	2.80E-07	2.80E-08	2.80E-08	8.36E+02	7.14E+04	1.32E-03	1.54E-05
Zinc	174	-	3.00E-01	8.54E-09	2.80E-08	2.80E-08	2.80E-08	-	1.07E+07	-	1.62E-05
IHSS 142.12											
Bis(2-ethylhexyl)phthalate	0.13	1.40E-02	2.00E-02	8.54E-08	2.80E-07	2.80E-08	2.80E-08	8.36E+02	7.14E+04	1.55E-04	1.82E-06
IHSS 216.1											
Methylene chloride	3.75	7.50E-03	6.00E-02	8.54E-08	2.80E-07	2.80E-08	2.80E-08	1.56E+03	2.14E+05	2.40E-03	1.75E-05
Barium	783	-	7.00E-02	8.54E-09	2.80E-08	2.80E-08	2.80E-08	-	2.50E+06	-	3.13E-04
Strontium	506	-	6.00E-01	8.54E-09	2.80E-08	2.80E-08	2.80E-08	-	2.14E+07	-	2.36E-05

⁽¹⁾ Analytes that were the largest contributors to the Ratio Sum on Section 5.0 tables were selected for the dermal exposure comparison.

Polycyclic aromatic hydrocarbons (PAHs) and radionuclides are not evaluated (see Section 6.1).

⁽²⁾ DOE 1994a. Units of slope factors are risk per mg chemical/kg body weight-day; units of reference doses (RfDs) are mg/chemical/kg body weight-day. Oral toxicity criteria were not adjusted for absorption or other corrections applicable to dermal contact.

⁽³⁾ Calculated using assumptions and equation shown in Section 6.1. Units are kg soil/kg body weight-day.

⁽⁴⁾ Carcinogenic RBC = Target Risk/(Intake Factor x Slope Factor)
Noncarcinogenic RBC = (Target Hazard Index x Reference Dose)/Intake Factor

DELINEATION OF AREAS OF CONCERN AND IDENTIFICATION OF MAXIMUM EXPOSURE AREAS

AOCs are defined as one or several source areas that are in close proximity and can be evaluated as a unit in the HHRA that will be included in the RFI/RI Report for OU6. A baseline HHRA will be conducted for each AOC, focusing on the area of maximum contamination (maximum exposure area) within each AOC. To assess health risk associated with hypothetical on-site residential use, a neighborhood exposure area of 10 acres has been agreed upon by CDPHE, EPA, and DOE. Larger exposure areas apply to other potential receptors, i.e., an office worker (30-acre industrial park) and ecological researcher (50-acre study area).

This section describes the AOCs for OU6 and the location of the 10-acre residential exposure area that captures the maximum contaminant levels in each AOC.

7.1 DELINEATION OF AOCs

Eighteen source areas were identified in OU6. Of these 18 source areas, 6 source areas are eliminated from further evaluation in an HHRA because they passed the CDPHE conservative screen for residential exposure to soil or sediment and they are not sources of groundwater contamination. These six source areas are IHSS 166 (Trenches A, B, and C), former IHSS 1673 (South Spray Field Area), IHSS 1424 (A-4 Pond), IHSS 1429 (B-5 Pond), IHSS 14212 (Walnut and Indiana Pond), and IHSS 2161 (East Spray Field). These IHSSs were not included in the delineation of AOCs for the HHRA. IHSS 143 (Old Outfall) is also excluded from further evaluation in the OU6 HHRA because it is proposed to be transferred to OU8.

The remaining 11 source areas can be grouped into four AOCs based on close proximity and similarity of exposure media, as described below. The four AOCs are shown on Figure 7-1.

AOC No. 1 is IHSS 1671 (North Spray Field). This source area is spatially separated from the other source areas that warrant further evaluation. AOC No. 1 is shown in Figure 7-2.

soil sampling locations associated with this IHSS will be used in the baseline HHRA for evaluating hypothetical residential exposures in this AOC (shown on Figure 7-2). Other exposure scenarios, if evaluated, will be assessed using the same data set.

AOC No. 2 includes IHSSs 165 (Triangle Area), 141 (Sludge Dispersal Area), and 156.2 (Soil Dump Area), as well as contaminated groundwater co-located within the Triangle Area and Sludge Dispersal Area. The greatest soil contamination is within the Triangle Area, as demonstrated by the relative magnitude of the soil and groundwater ratio sums for these IHSSs (Table 5-1). Therefore, the Triangle Area, which is approximately 10 acres, is selected as the maximum exposure area for a hypothetical long-term resident in AOC No. 2 (shown on Figure 7-3). The greatest groundwater contamination in AOC No. 2 is not associated with the Triangle Area, which is in groundwater area 4, but rather in groundwater area 3, specifically well 3586, which is upgradient of the Sludge Dispersal Area. As a conservative measure, data from groundwater samples collected within the entire AOC No. 2 will be used in the baseline HHRA for this AOC. Figure 7-3 also shows 30- and 50-acre grids for the industrial worker and ecological researcher exposure scenarios.

AOC No. 3 includes Ponds A-1, A-2, and A-3. The combined area of these IHSSs is roughly 10 acres and the three ponds are considered together in the exposure assessment. All sediment data (pond, stream, and dry), as well as surface water and groundwater data collected from sampling locations within the North Walnut Creek drainage containing these ponds will be used in the baseline HHRA for this AOC. However, in the HHRA, long-term residential or industrial use may not be considered a reasonable maximum exposure scenario for ponds, since construction cannot occur in the drainages. Since the ecological researcher is a more reasonable maximum exposed individual, a 50-acre grid is shown on Figure 7-4.

AOC No. 4 includes Ponds B-1 through B-4. These ponds together are designated as the maximum exposure area, and will be evaluated as described for A-series ponds in AOC No. 3. The 50-acre grid for Ponds B-1 through B-4 is shown on Figure 7-5.

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No 9355 4-12 July 14

U S Environmental Protection Agency (EPA) 1991a. Human Health Evaluation Manual. Supplemental Guidance. Standard Default Exposure Factors OSWER Directive 9285 6-03

U S Environmental Protection Agency (EPA) 1991b Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions OSWER Directive 9355 0-30

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ATTACHMENT 1

BACKGROUND COMPARISON SUMMARY TABLES

The following tables summarize the results of the statistical background comparison for metals and radionuclides in surface soil, subsurface soil, pond sediment, stream sediment, pond surface water (unfiltered samples) and UHSU groundwater (unfiltered samples). The background comparison is used to identify inorganic potential chemicals of concern (PCOCs) for further evaluation in assessing nature and extent of contamination and in selecting chemicals of concern for risk assessment. A PCOC is a metal or radionuclide that either (1) is shown to be significantly above background levels by one or more of four statistical tests (Slippage, Quantile, Gehan, or t-test) or (2) has one or more results exceeding the 99% upper tolerance limit (UTL) of the background data. PCOCs are selected on an OU-wide basis, pooling all analytical results for each medium sampled.

The background comparison methodology is described in more detail in Gilbert (1993) and DOE (1994).

References

Gilbert, R.O. 1993. Letter report recommending process for comparing Rocky Flats site analytical results to background concentrations. Richard Gilbert, Batelle Pacific Northwest Laboratories, to Beverly Ramsey, Systematic Management Services, Inc. July 30.

U.S. Department of Energy (DOE). 1994. Technical Memorandum No. 4, Chemicals of Concern, Human Health Risk Assessment, Walnut Creek Priority Drainage, Operable Unit No. 6. Rocky Flats Environmental Technology Site. Golden, Colorado. Environmental Management Department. Draft Final. August 1994.

ATTACHMENT 1
TABLE LEGEND

N_B	Number of background samples
N_S	Number of site samples
DTF_B	Detection frequency in background samples
DTF_S	Detection frequency in site samples
P_SLIP	p-value, Slippage test
P_QUAN	p-value, Quantile test
P_GEHAN	p-value, Gehan test
P_T_1	p-value, Student's t-test
SIGNIFICT	Significant difference from background based on formal statistical tests ($p \leq 0.05$)
UTL9999	percent upper tolerance limit of background data at the 99 percent confidence level
NGUTL	Number of site sample results > UTL99
PCOC	Potential chemical of concern

TABLE AT1-1
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY
OF SURFACE SOIL METALS
(Concentration Unit: MG/KG)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P T 1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
ALUMINUM	18	119	1.00	1.00	0.2320	0.7081	0.9976	1.0000	N	21915.4	3	NO	Not a PCOC by PJ (1)
ANTIMONY	18	103	0.00	0.54	1.0000		0.0174		Y	50.0	0	YES	
ARSENIC	18	119	1.00	1.00	0.4222	0.8522	0.8614	0.7828	N	12.9	0	NO	
BARIUM	18	119	1.00	1.00	1.0000	0.9975	0.9914	0.9912	N	528.0	0	NO	
BERYLLIUM	18	119	0.50	0.87	1.0000		0.4634		N	5.2	0	NO	
CADMIUM	17	119	0.35	0.47	0.8750		0.3602		N	5.0	1	NO	Not a PCOC by PJ (1)
CALCIUM	18	119	1.00	1.00	0.0001	0.0119	0.0001	0.0001	Y	13573.3	24	YES	
CESIUM	18	114	0.50	0.91	1.0000		0.2843		N	630.8	0	NO	
CHROMIUM	18	119	1.00	0.99	0.6532	0.9848	0.9998	1.0000	N	24.8	1	YES	
COBALT	18	119	1.00	1.00	1.0000	0.1921	0.0028	0.0057	Y	24.8	0	YES	
COPPER	18	119	1.00	1.00	0.0099	0.0119	0.0007	0.0001	Y	27.3	7	YES	
IRON	18	119	1.00	1.00	0.6532	0.4417	0.9190	0.8919	N	28160.4	3	YES	
LEAD	18	119	1.00	1.00	0.0909	0.4743	0.9995	1.0000	N	61.4	4	YES	
LITHIUM	18	119	1.00	0.97	0.1707		0.9889	0.9997	N	20.0	0	NO	
MAGNESIUM	18	119	1.00	1.00	0.4222	0.7081	0.3266	0.2969	N	7011.5	3	YES	
MANGANESE	18	119	1.00	1.00	1.0000	0.9557	0.9998	0.9999	N	2253.5	0	NO	
MERCURY	18	119	0.00	0.41	0.8686		0.0303		Y	0.2	1	YES	
MOLYBDENUM	18	119	0.06	0.01	1.0000		0.0185		Y	40.0	0	YES	
NICKEL	18	118	1.00	0.95	0.1228	0.4348	0.0308	0.1363	Y	26.9	0	YES	
POTASSIUM	18	119	1.00	0.92	0.8686	1.0000	1.0000	1.0000	N	5256.8	0	NO	
SELENIUM	18	119	0.72	0.27	1.0000		0.2903		N	1.4	0	NO	
SILICON	0	0	0.00	0.00									NO data measurement
SILVER	18	119	0.00	0.09	0.8686		0.2388		N	10.0	1	YES	
SODIUM	18	119	0.50	1.00	0.6532		0.0547		N	1108.0	3	YES	
STRONTIUM	18	119	1.00	1.00	0.2320	0.0769	0.0714	0.0397	Y	90.1	6	YES	
THALLIUM	18	118	0.28	0.42	1.0000		0.6887		N	2.0	0	NO	
TIN	18	119	0.50	0.03	1.0000		1.0000		N	75.9	0	NO	
VANADIUM	18	119	1.00	1.00	0.2700	0.2375	0.4443	0.5916	N	55.6	4	YES	
ZINC	18	119	1.00	1.00	0.0099	0.0119	0.1244	0.0028	Y	86.6	11	YES	

(1) Professional judgment based on log-normal UTL comparison

TABLE AT1-2
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
SURFACE SOIL RADIONUCLIDES
(Concentration Unit: pCi/G)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P T 1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	15	105	100	100	0.0001	0.0277	0.0001		Y	0.060	63	YES	
CESIUM-137	12	18	100	100	1.0000	1.0000	1.0000		N	3.699	0	NO	
GROSS ALPHA	9	134	100	100	0.4760	0.9174	0.9847		N	42.220	3	YES	
GROSS BETA	18	134	100	100	0.3111	0.8711	0.9778		N	54.120	2	YES	
PLUTONIUM-239,240	18	118	100	100	0.0001	0.0114	0.0001		Y	0.133	73	YES	
RADIUM-226	10	0	0.00	0.00									NO site measurement
RADIUM-228	10	0	0.00	0.00									NO site measurement
STRONTIUM-89,90	9	18	100	100	1.0000	1.0000	0.9992		N	2.217	0	NO	
TRITIUM (1)	0	27	0.00	0.00									NO BKGD measurement
URANIUM, TOTAL	0	0	0.00	0.00									NO measurements
URANIUM-233,234	13	125	100	100	0.2893	0.7453	0.9844		N	1.826	1	NO	Not a PCOC by PJ (2)
URANIUM-235	13	125	100	100	0.4433	0.7453	0.5160		N	0.179	0	NO	
URANIUM-238	13	125	100	100	0.4922	0.9064	0.9788		N	2.086	0	NO	

(1) Concentration unit, pCi/L

(2) Professional judgment based on log-normal UTIL comparison

TABLE AT1-3
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
SUBSURFACE SOIL METALS
 (Concentration Unit: MG/KG)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P J 1	SIGNIFICT	UTIL99	NGUTL	FOOC	REMARK
ALUMINUM	98	231	1.00	1.00	1.0000	1.0000	1.0000	1.0000	N	45083.1	0	NO	
ANTIMONY	66	210	0.18	0.07	1.0000		0.1658		N	47.0	0	NO	
ARSENIC	99	231	0.81	0.99	1.0000	0.8480	0.3116	0.7937	N	17.0	0	NO	
BARIUM	99	231	0.92	1.00	0.1153	0.0006	0.0001	0.0004	Y	371.1	17	YES	
BERYLLIUM	99	231	0.91	0.84	1.0000	1.0000	1.0000	1.0000	N	18.2	0	NO	
CADMIUM	81	211	0.48	0.08	1.0000		1.0000		N	2.0	0	NO	
CALCIUM	99	231	0.90	1.00	0.0385	0.0001	0.0001	0.0001	Y	53248.1	52	YES	
CESIUM	95	221	0.78	0.68	1.0000		1.0000		N	1014.9	0	NO	
CHROMIUM	99	231	1.00	0.98	0.7000	1.0000	1.0000	0.9998	N	89.1	3	YES	
COBALT	99	231	0.34	0.95	1.0000		0.9996		N	38.1	0	NO	
COPPER	99	231	0.97	1.00	1.0000	0.9931	0.9998	0.9978	N	49.0	1	NO	Not a FOOC by PJ (1)
IRON	99	231	1.00	1.00	1.0000	0.9999	1.0000	0.9999	N	52385.2	0	NO	
LEAD	99	231	1.00	1.00	0.4894	0.9548	0.1262	0.2347	N	31.0	2	YES	
LITHIUM	99	209	0.48	0.87	1.0000		1.0000		N	41.9	0	NO	
MAGNESIUM	99	231	0.71	1.00	1.0000	0.8663	0.5339		N	12147.1	0	NO	
MANGANESE	99	231	1.00	1.00	1.0000	0.9998	0.9998	0.9813	N	1194.0	0	NO	
MERCURY	86	231	0.38	0.31	1.0000		1.0000		N	2.1	0	NO	
MOLYBDENUM	99	231	0.18	0.02	1.0000		0.9848		N	67.6	0	NO	
NICKEL	96	231	0.96	0.66	1.0000	1.0000	1.0000		N	79.9	0	NO	
POTASSIUM	98	230	0.40	0.60	1.0000		1.0000		N	8362.3	0	NO	
SELENIUM	82	211	0.27	0.09	1.0000		1.0000		N	7.1	0	NO	NO site measurement
SILICON													
SILVER	83	230	0.43	0.00	1.0000		1.0000		N	33.1	0	NO	
SODIUM	99	231	0.18	1.00	1.0000		0.9989		N	3680.0	0	NO	
STRONTIUM	99	231	0.43	1.00	0.7000		0.0003		Y	269.9	6	YES	
THALLIUM	75	223	0.05	0.29	1.0000		0.8231		N	20.0	0	NO	
TIN	92	231	0.23	0.03	1.0000		1.0000		N	383.7	0	NO	
VANADIUM	99	231	0.98	1.00	1.0000	0.9998	1.0000	0.9982	N	112.8	1	YES	
ZINC	98	231	1.00	1.00	0.7021	0.9259	0.8970	0.6826	N	182.9	4	YES	

(1) Professional judgment based on log-normal UTL comparison

TABLE AT1-4
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
SUBSURFACE SOIL RADIONUCLIDES
(Concentration Unit: pCi/G)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P T 1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	28	208	1 00	1 00	0 0001	0 0009	0 0001	0 0228	Y	0 022	21	YES	
CESIUM-137	99	0											
GROSS ALPHA	99	209	1 00	1 00	0 4597	1 0000	1 0000	1 0000	N	51 423	2	YES	NO site measurement
GROSS BETA	99	223	1 00	1 00	1 0000	1 0000	1 0000	1 0000	N	42 022	0	NO	
PLUTONIUM-239,240	99	206	1 00	1 00	0 0001	0 0001	0 0001	0 0001	Y	0 025	43	YES	
RADIUM-226	83	0											
RADIUM-228	83	0											
STRONTIUM-89,90	99	0											
TRITIUM (l)	99	12	1 00	1 00	1 0000	0 9479	0 9564		N	503 616	0	NO	NO site measurement
URANIUM,TOTAL	0	0											
URANIUM-233,234	99	230	1 00	1 00	1 0000	0 0256	0 0344	0 2701	Y	3 441	0	YES	NO site measurement
URANIUM-235	99	230	1 00	1 00	1 0000	0 4617	0 0001	0 0009	Y	0 153	1	YES	NO site measurement
URANIUM-238	99	230	1 00	1 00	0 6991	0 8497	0 3157	0 2637	N	1 807	2	YES	NO site measurement

(1) Concentration Unit. pCi/L

TABLE AT1-5
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
UHSU GROUNDWATER UNFILTERED METALS
(Concentration Unit: UG/L)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P T 1	SIGNIFIC	UTL99	NGUIL	POOC	REMARK
ALUMINUM	149	106	0.95	0.95	0.0001	0.0001	0.0001	0.0007	Y	25624.6	18	YES	
ANTIMONY	141	92	0.38	0.16	0.0090		0.0211		Y	55.8	7	YES	
ARSENIC	138	106	0.28	0.52	0.0147		0.0001		Y	8.8	6	YES	
BARIUM	149	107	0.74	0.98	0.0001	0.0001	0.0001		Y	300.4	32	YES	
BERYLLIUM	148	100	0.12	0.30	0.0002		0.0001		Y	5.0	9	YES	
CADMIUM	148	106	0.20	0.26	0.0049		0.0177		Y	11.1	6	YES	
CALCIUM	149	107	1.00	1.00	0.0001	0.0001	0.0001	0.0001	Y	145353.0	32	YES	
CESIUM	142	97	0.25	0.02	1.0000		0.1380		N	934.7	0	NO	
CHROMIUM	145	107	0.48	0.75	1.0000	0.0001	0.0001		Y	186.4	7	YES	
COBALT	148	107	0.16	0.45	0.0020		0.0001		Y	50.0	7	YES	
COPPER	148	107	0.74	0.54	0.0001		0.0001		Y	45.3	20	YES	
IRON	149	106	0.98	0.95	0.0019	0.0001	0.0001	0.0012	Y	31518.5	18	YES	
LEAD	141	107	0.70	0.73	0.0002	0.0001	0.0001		Y	19.3	21	YES	
LITHIUM	149	107	0.77	0.93	0.0008		0.0001		Y	172.3	17	YES	
MAGNESIUM	149	107	0.97	1.00	0.0001	0.0001	0.0001	0.0001	Y	33005.6	42	YES	
MANGANESE	149	107	0.89	0.94	0.0001	0.0001	0.0001	0.0001	Y	626.4	30	YES	
MERCURY	148	107	0.20	0.10	0.0008		0.9745		Y	0.2	9	YES	
MOLYBDENUM	150	107	0.34	0.27	1.0000		0.0738		N	195.1	0	NO	
NICKEL	146	107	0.38	0.66	0.1779		0.0001		Y	97.5	12	YES	
POTASSIUM	150	107	0.71	0.94	0.0001		0.0001		Y	5178.8	39	YES	
SELENIUM	145	106	0.30	0.58	0.4223	0.0001	0.0001		Y	127.5	18	YES	
SILICON	84	66	0.99	1.00	0.0011	0.0001	0.0258	0.0005	Y	61390.0	12	YES	
SILVER	147	104	0.16	0.20	0.0003		0.0017		Y	10.0	9	YES	
SODIUM	149	107	0.99	1.00	0.0001	0.0001	0.0001	0.0001	Y	144226.0	26	YES	
STRONTIUM	146	106	0.89	1.00	0.0001	0.0001	0.0001	0.0001	Y	1085.4	33	YES	
THALLIUM	146	107	0.24	0.05	1.0000		0.5107		N	9.0	0	NO	
TIN	149	106	0.35	0.19	0.1718		0.2361		N	179.2	3	NO	Not a POOC by P1 (1)
VANADIUM	149	107	0.77	0.74	0.0003		0.0001		Y	68.2	19	YES	
ZINC	149	107	0.91	0.83	0.0008	0.0001	0.0001	0.0142	Y	179.2	22	YES	

(1) Professional judgment based on log-normal UTL comparison

TABLE AT1-6
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
UHSU GROUNDWATER UNFILTERED RADIONUCLIDES
(Concentration Unit: pCi/L)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P T 1	SIGNIFCT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	183	131	1 00	1 00	0 0020	0 0018	0 0151		Y	0 037	16	YES	
CESIUM-137	156	68	1 00	1 00	0 0912	0 3756	0 1002		N	1 065	2	YES	
GROSS ALPHA	23	7	1 00	1 00	1 0000	0 1201	0 0775		N	390 578	0	NO	
GROSS BETA	23	7	1 00	1 00	1 0000	0 1201	0 1056		N	221 307	0	NO	
PLUTONIUM-239,240	194	138	1 00	1 00	0 0003	0 0001	0 0001		Y	0 064	12	YES	
RADIUM-226	6	6	1 00	1 00	0 0303	0 0909	0 0547		Y	1 295	1	YES	
RADIUM-228	0	3	0 00	0 00									NO BKGD measurement
STRONTIUM-89,90(1)	32	3	1 00	1 00	0 0857	0 0952	0 0259		Y	1 154	1	YES	
TRITIUM	84	238	1 00	1 00	1 0000	0 3271	0 1193		N	12982 300	0	NO	
URANIUM, TOTAL	0	0	0 00	0 00									NO measurements
URANIUM-233,234(1)	35	4	1 00	1 00	1 0000	1 0000	0 3730		N	144 836	0	NO	
URANIUM-235(1)	35	4	1 00	1 00	1 0000	1 0000	0 7981		N	5 233	0	NO	
URANIUM-238(1)	22	4	1 00	1 00	1 0000	0 6759	0 1776		N	114 171	0	NO	

(1) Sample size is too small

TABLE AT1-7
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
POND SEDIMENTS METALS
(Concentration Unit: MG/KG)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P T 1	SIGNIFIC	UTL99	NGUTL	PCOC	REMARK
ALUMINUM	20	57	1.00	1.00	0.4000	0.3476	0.1135	0.2025	N	29553.4	0	NO	
ANTIMONY	18	28	0.44	0.39	0.6087		0.3327		N	55.0	1	YES	
ARSENIC	20	57	0.90	1.00	1.0000		0.5749	0.9802	N	66.7	0	NO	
BARIUM	20	57	1.00	1.00	1.0000	0.9300	0.3577	0.8872	N	794.9	0	NO	
BERYLLIUM	16	57	0.81	0.98	0.3629		0.1331		N	5.6	4	NO	Not a PCOC by PJ (1)
CADMIUM	16	56	0.88	0.39	0.6025		0.9911		N	8.8	1	NO	Not a PCOC by PJ (1)
CALCIUM	20	57	1.00	1.00	0.7403	0.9300	0.4400	0.7545	N	80941.3	0	NO	
CESIUM	17	57	1.00	0.93	1.0000		1.0000		N	1259.1	0	NO	
CHROMIUM	18	57	1.00	1.00	0.0377	0.0704	0.0172		Y	31.2	6	YES	
COBALT	19	57	0.95	1.00	1.0000	0.8358	0.0340	0.3018	Y	35.1	0	YES	
COPPER	19	57	1.00	1.00	1.0000	0.6377	0.0047	0.3555	Y	174.7	0	YES	
IRON	19	57	1.00	1.00	1.0000	0.9440	0.0235	0.8936	Y	143862.0	0	YES	
LEAD	19	57	1.00	1.00	1.0000	0.9859	0.7115	0.8849	N	261.1	0	NO	
LITHIUM	18	57	1.00	0.98	1.0000		0.9875		N	106.7	0	NO	
MAGNESIUM	20	57	1.00	1.00	0.0785	0.0365	0.0001	0.0001	Y	6328.5	0	YES	
MANGANESE	20	57	0.70	1.00	1.0000	0.9300	0.0238		Y	1993.1	0	YES	
MERCURY	15	56	1.00	0.43	0.7887	0.9467	0.9994		N	1.7	0	NO	
MOLYBDENUM													
NICKEL	17	56	1.00	0.70	0.7671	0.5169	0.1637		N	44.3	1	NO	NO side measurement
POTASSIUM	18	56	1.00	0.89	0.0496	0.0662	0.0008		Y	3872.2	0	YES	Not a PCOC by PJ (1)
SELENIUM	19	57	0.89	0.05	1.0000		1.0000		N	5.3	0	NO	
SILICON													
SILVER	15	57	0.87	0.39	0.0054	0.0191	0.3114		Y	11.5	19	YES	NO side measurement
SODIUM	20	57	0.85	1.00	1.0000	0.5983	0.0119	0.5326	Y	2610.3	0	YES	
STRONTIUM	20	57	1.00	1.00	1.0000	0.9962	0.8340	0.9479	N	621.7	0	NO	
THALLIUM	13	56	0.69	0.39	1.0000		1.0000		N	13.6	0	NO	
TIN	19	56	0.95	0.02	1.0000		0.9953		N	103.3	0	NO	
VANADIUM	19	57	1.00	1.00	0.7500	0.6377	0.0028	0.0762	Y	83.0	0	YES	
ZINC	20	57	1.00	1.00	0.0001	0.0042	0.0001	0.0001	Y	143.0	19	YES	

(1) Professional judgment based on log-normal UTL comparison.

TABLE AT1-8
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
POND SEDIMENT RADIONUCLIDES
(Concentration Unit: pCi/G)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P T 1	SIGNIFICT	UTL99	NGUIL	PCOC	REMARK
AMERICIUM-241	14	48	1 00	1 00	0 0005	0 0232	0 0001		Y	1 472	22	YES	
CESIUM-137	13	46	1 00	1 00	1 0000	0 9833	0 9966		N	3 510	0	NO	
GROSS ALPHA	15	55	1 00	1 00	0 0062	0 0225	0 0016		Y	78 829	9	YES	
GROSS BETA	14	56	1 00	1 00	0 0688	0 4299	0 0006		Y	45 966	3	YES	
PLUTONIUM-239,240	16	47	1 00	1 00	0 0018	0 0134	0 0001		Y	7 678	17	YES	
RADIUM-226	9	5	1 00	1 00	0 0005	0 0050	0 0013		Y	1 973	0	YES	
RADIUM-228	9	5	1 00	1 00	0 0005	0 0275	0 0013		Y	2 884	0	YES	
STRONTIUM-89,90	14	25	1 00	1 00	0 6410	0 7033	0 0188		Y	2 649	0	YES	
TRITIUM (1)	13	41	1 00	1 00	0 4298	0 1853	0 7110		N	769 750	2	NO	Not a PCOC by PJ (2)
URANIUM,TOTAL	0	0	0 00	0 00									NO HIT
URANIUM-233,234	16	50	1 00	1 00	0 0001	0 0121	0 0001		Y	2 389	8	YES	
URANIUM-235	17	50	1 00	1 00	0 2194	0 0712	0 0015		Y	0 248	5	YES	
URANIUM-238	14	50	1 00	1 00	0 0016	0 0270	0 0001		Y	2 540	8	YES	

(1) Concentration Unit. pCi/L

(2) Professional judgment based on log-normal UTL comparison.

TABLE AT1-9
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
POND SURFACE WATER UNFILTERED METALS
(Concentration Unit: UG/L)

ANALYTE	N B	N S	DTE B	DTE S	P SLIP	P QUAN	P GEHAN	P I 1	SIGNIFICT	UTL9	NGUTL	POOC	REMARK
ALUMINUM	44	49	0.91	0.98	1.0000	1.0000	1.0000	0.9937	N	176057.0	0	NO	
ANTIMONY	30	51	0.37	0.06	1.0000		0.9952		N	448.7	0	NO	
ARSENIC	40	51	0.65	0.41	1.0000		0.9996		N	727.5	0	NO	
BARIUM	40	51	0.83	1.00	1.0000	1.0000	1.0000	0.9992	N	6697.9	0	NO	
BERYLLIUM	34	51	0.38	0.04	1.0000		0.9983		N	14.6	0	NO	
CADMIUM	29	51	0.34	0.22	1.0000		1.0000		N	73.2	0	NO	
CALCIUM	48	51	1.00	1.00	1.0000	1.0000	1.0000	0.9997	N	521669.0	0	NO	
CESIUM	29	51	0.28	0.12	1.0000		0.9735		N	1942.1	0	NO	
CHROMIUM	36	51	0.44	0.16	1.0000		1.0000		N	196.6	0	NO	
COBALT	31	51	0.39	0.35	1.0000		0.9999		N	375.2	0	NO	
COPPER	40	47	0.58	0.19	1.0000		1.0000		N	385.9	0	NO	
IRON	46	51	0.98	1.00	1.0000	1.0000	1.0000	0.9900	N	1915387.0	0	NO	
LEAD	41	50	0.71	0.78	1.0000	1.0000	0.9995		N	796.4	0	NO	
LITHIUM	31	51	0.55	1.00	1.0000		0.8200		N	125.0	0	NO	
MAGNESIUM	46	51	0.87	1.00	1.0000	0.0657	0.0655	0.0188	Y	35266.9	0	YES	
MANGANESE	47	51	0.87	1.00	1.0000	0.9756	0.3282	0.9898	N	18404.9	0	NO	
MERCURY	29	51	0.21	0.33	1.0000	0.5002	0.3482		N	1.1	0	NO	
MOLYBDENUM	29	51	0.31	0.75	1.0000		0.9538		N	197.2	0	NO	
NICKEL	31	51	0.42	0.47	1.0000		1.0000		N	476.0	0	NO	
POTASSIUM	37	51	0.54	1.00	1.0000	0.0478	0.0002		Y	13719.0	0	YES	
SELENIUM	32	49	0.38	0.22	1.0000		0.9575		N	16.6	0	NO	
SILICON	11	51	1.00	1.00	1.0000	1.0000	1.0000		N	23029.6	0	NO	
SILVER	28	47	0.36	0.06	1.0000		0.9996		N	107.1	0	NO	
SODIUM	48	51	0.98	1.00	0.0001	0.0001	0.0001	0.0001	Y	27145.6	30	YES	
STRONTIUM	37	51	0.70	1.00	1.0000		0.9900		N	2167.9	0	NO	NO HIT
THALLIUM	35	51	0.11	0.00									
TIN	31	51	0.42	0.20	1.0000		0.9996		N	794.7	0	NO	
VANADIUM	37	51	0.57	0.49	1.0000		1.0000		N	1096.5	0	NO	
ZINC	46	51	0.89	0.76	1.0000	1.0000	1.0000		N	1625.9	0	NO	

TABLE AT1-10
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
POND SURFACE WATER UNFILTERED RADIONUCLIDES
(Concentration Unit: pCi/L)

ANALYTE	N B	N S	D T F B	D T F S	P S L P	P Q U A N	P G E H A N	P T 1	S I G N I F I C T	U T L 9 9	N G U T L	P C O C	R E M A R K
AMERICIUM-241	37	49	1 00	1 00	1 0000	0 5703	0 1674		N	0 080	0	NO	
CESIUM-137	37	18	1 00	1 00	1 0000	1 0000	0 9796		N	7 157	0	NO	
GROSS ALPHA	36	48	1 00	1 00	1 0000	1 0000	0 9284		N	340 129	0	NO	
GROSS BETA	10	51	1 00	1 00	0 0001	0 0725	0 0001		Y	9 742	13	YES	
PLUTONIUM-239,240	33	51	1 00	1 00	1 0000	0 9825	0 9268		N	2 849	0	NO	
RADIUM-226	12	0	0 00	0 00									NO site measurement
RADIUM-228	5	0	0 00	0 00									NO site measurement
STRONTIUM-89,90	32	51	1 00	1 00	0 2267	0 4931	0 1420		N	1 614	0	NO	
TRITIUM	31	46	1 00	1 00	1 0000	0 5178	0 4917		N	4277 820	0	NO	
URANIUM, TOTAL	0	0	0 00	0 00									NO measurements
URANIUM-233,234	33	51	1 00	1 00	1 0000	0 0352	0 0001		Y	4 988	0	YES	
URANIUM-235	32	51	1 00	1 00	0 0161	0 0266	0 0032		Y	0 307	4	YES	
URANIUM-238	28	51	1 00	1 00	1 0000	0 0995	0 0008		Y	4 885	0	YES	

TABLE AT1-11
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
STREAM SEDIMENT METALS
(Concentration Unit: MG/KG)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P T 1	SIGNIFCT	UTL99	NGUTL	FOOC	REMARK
ALUMINUM	59	15	1.00	1.00	1.0000	0.6358	0.0703		N	20880.1	0	NO	
ANTIMONY	52	15	0.17	0.13	1.0000		0.4121		N	60.0	0	NO	
ARSENIC	59	15	0.49	0.93	1.0000		0.0007		Y	10.1	0	YES	
BARIUM	57	15	1.00	1.00	1.0000	0.8810	0.0197		Y	250.8	0	YES	
BERYLLIUM	57	15	0.53	0.53	1.0000		0.5367		N	11.6	0	NO	
CADMIUM	51	15	0.29	0.07	1.0000		0.9908		N	3.5	0	NO	
CALCIUM	59	15	1.00	1.00	0.2027	0.0092	0.0001		Y	17888.3	1	YES	
CESIUM	56	15	0.86	0.47	1.0000	1.0000	0.9998		N	513.5	0	NO	
CHROMIUM	59	15	0.83	1.00	1.0000	0.8947	0.4866		N	31.1	0	NO	
COBALT	59	15	0.88	1.00	1.0000		0.0021		Y	19.3	0	YES	
COPPER	59	15	0.80	0.60	1.0000	0.6871	0.7164		N	36.0	0	NO	
IRON	59	15	1.00	1.00	1.0000	0.1471	0.0001		Y	27966.4	0	YES	
LEAD	59	15	1.00	1.00	1.0000	0.6358	0.0602		N	134.3	0	NO	
LITHIUM	57	15	0.91	0.93	1.0000		0.7018		N	41.3	0	NO	
MAGNESIUM	59	15	1.00	1.00	1.0000	0.0436	0.0014		Y	5262.0	0	YES	
MANGANESE	59	15	0.80	1.00	1.0000	0.0436	0.0024		Y	905.0	1	YES	
MERCURY	49	15	0.86	0.27	1.0000		1.0000		N	0.5	0	NO	NO site measurement
MOLYBDENUM	0	0	0.00	0.00									
NICKEL	57	15	0.88	0.47	1.0000		0.3626		N	24.2	0	NO	
POTASSIUM	58	15	1.00	0.93	1.0000	0.0100	0.0002		Y	3112.5	0	YES	
SELENIUM	58	15	0.40	0.13	1.0000		0.8914		N	3.5	0	NO	NO site measurement
SILICON	0	0	0.00	0.00									
SILVER	54	15	0.48	0.07	1.0000		0.9170		N	12.0	0	NO	
SODIUM	59	15	0.69	0.87	1.0000		0.0806		N	1745.1	0	NO	
STRONTIUM	58	15	0.88	1.00	1.0000		0.0079		Y	294.8	0	YES	
THALLIUM	50	15	0.40	0.33	1.0000		0.8391		N	2.3	0	NO	
TIN	0	0	0.00	0.00									NO site measurement
VANADIUM	57	15	0.70	1.00	1.0000		0.0128		Y	63.4	0	YES	
ZINC	59	15	0.95	1.00	1.0000	0.0144	0.0005		Y	307.8	0	YES	

TABLE AT1-12
ROCKY FLATS OU6
BACKGROUND COMPARISON SUMMARY OF
STREAM SEDIMENT RADIONUCLIDES
(Concentration Unit: pCi/G)

ANALYTE	N B	N S	DTF B	DTF S	P SLIP	P QUAN	P GEHAN	P T 1	SIGNIFICT	UTL99	NGUTL	PCOC	REMARK
AMERICIUM-241	37	15	100	100	10000	0.3923	0.0031		Y	1770	0	YES	
CESIUM-137	35	15	100	100	10000	0.9821	0.5551		N	1541	0	NO	
GROSS ALPHA	45	15	100	100	10000	10000	0.6776		N	88058	0	NO	
GROSS BETA	43	15	100	100	10000	10000	10000		N	67337	0	NO	
PLUTONIUM-239,240	45	15	100	100	10000	0.0355	0.0059		Y	5658	0	YES	
RADIUM-226	21	1	100	100	10000	10000	0.3466		N	2216	0	NO(1)	
RADIUM-228	20	1	100	100	10000	10000	0.4344		N	4547	0	NO(1)	
STRONTIUM-89,90	43	8	100	100	10000	0.5572	0.6464		N	1087	0	NO	
TRITIUM(2)	42	15	100	100	0.2632	0.0460	0.5576		Y	1047685	1	YES	NO site measurement
URANIUM,TOTAL	0	0											
URANIUM-233,234	47	15	100	100	10000	10000	0.9942		N	5293	0	NO	
URANIUM-235	49	15	100	100	10000	10000	0.9351		N	0.212	0	NO	
URANIUM-238	36	15	100	100	10000	10000	0.9530		N	4817	0	NO	

(1) Sample size is too small

(2) Concentration Unit: pCi/L

ATTACHMENT 2
BACKGROUND SCREENING LEVELS TABLE

TABLE AT2-1
ROCKY FLATS OU6
BACKGROUND SCREENING LEVELS
 (Background Mean plus 2 Standard Deviations)

Analyte	UHSU					Pond Surface	
	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)	Groundwater (unfiltered) (mg/l)	Seep/Spring Sediment (mg/kg)	Stream Sediment (mg/kg)	Water (unfiltered) (mg/l)	
METALS							
ALUMINUM	17445 92	35373 20	19 01	20375 70	15713 00	117 56	
ANTIMONY	35 05	17 80	0 05	34 00	23 20	0 28	
ARSENIC	9 39	13 20	0 01	40 90	7 40	0 48	
BARIUM	362 86	289 00	0 24	514 30	190 70	4 51	
BERYLLIUM	3 43	14 20	0 00	3 40	8 00	0 01	
CADMIUM	3 21	1 70	0 00	5 50	2 50	0 05	
CALCIUM	9340 53	39393 60	118 37	51526 70	12984 60	367 88	
CESIUM	381 00	777 50	0 77	796 20	382 70	1 31	
CHROMIUM	19 98	68 20	0 13	21 20	23 30	0 13	
COBALT	16 39	29 20	0 04	22 70	14 90	0 24	
COPPER	20 22	38 10	0 04	103 10	27 40	0 26	
IRON	21834 90	41046 60	23 27	86348 60	21379 00	1280 47	
LEAD	49 58	24 90	0 01	157 50	95 60	0 53	
LITHIUM	15 53	33 70	0 13	64 60	30 80	0 09	
MAGNESIUM	4953 23	9319 30	26 23	4473 00	3963 70	26 30	
MANGANESE	1357 58	901 60	0 47	1192 40	667 90	12 37	
MERCURY	0 13	1 50	0 00	0 90	0 30	0 00	
MOLYBDENUM	25 52	33 50	0 16	0 00	0 00	0 13	
NICKEL	19 69	62 10	0 07	28 90	18 70	0 30	
POTASSIUM	4128 77	6339 60	4 18	2598 80	2349 70	9 80	
SELENIUM	1 02	5 30	0 09	3 50	2 50	0 01	
SILICON	2184 11	N/A	47 38	0 00	0 00	14 46	
SILVER	7 12	24 60	0 01	6 90	8 50	0 07	
SODIUM	710 82	1749 00	110 12	1539 60	1248 50	21 81	
STRONTIUM	62 98	209 80	0 85	386 50	210 40	1 52	
THALLIUM	1 44	3 70	0 01	7 20	1 70	0 00	
TIN	53 87	287 00	0 15	66 40	0 00	0 51	
VANADIUM	43 70	88 50	0 05	56 00	47 90	0 72	
ZINC	71 39	139 10	0 14	101 50	220 30	1 10	

TABLE AT2-1
(Concluded)

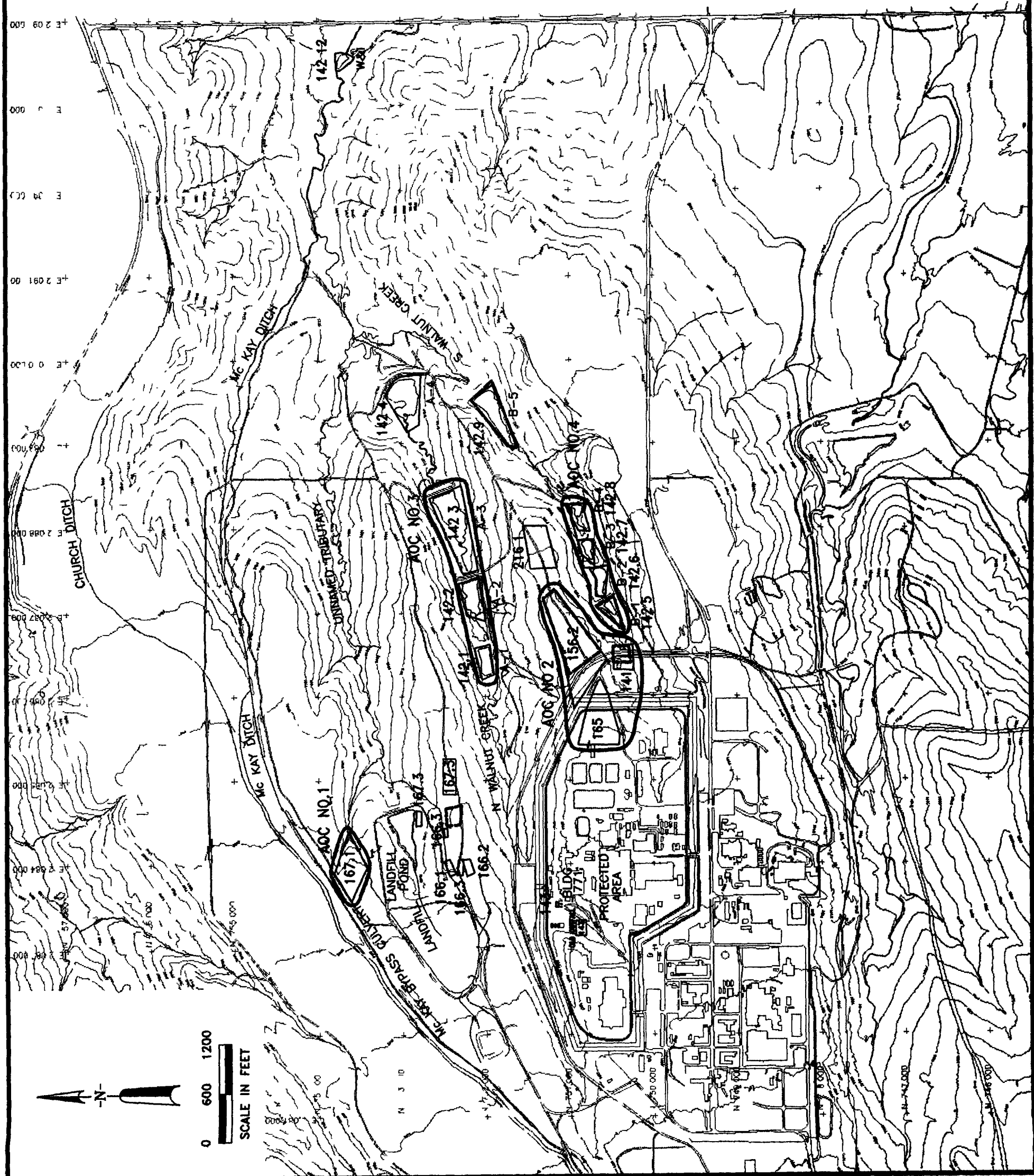
Analyte	UHSU						Pond Surface	
	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)	Groundwater (unfiltered) (mg/l)	Seep/Spring Sediment (mg/kg)	Stream Sediment (mg/kg)	Water (unfiltered) (mg/l)		
RADIONUCLIDES								
AMERICIUM-241	0.04	0.01	0.03	0.74	1.14	0.05		
CESIUM-137	2.40	0.09	0.78	2.02	1.03	4.57		
GROSS ALPHA	28.77	43.48	232.07	47.71	63.90	222.05		
GROSS BETA	43.29	36.84	131.63	33.89	55.31	5.14		
PLUTONIUM-239,240	0.09	0.02	0.05	4.04	3.76	1.78		
RADIUM-226	1.20	1.21	0.61	1.18	1.57	0.00		
RADIUM-228	3.23	2.04	N/A	1.81	3.19	0.00		
STRONTIUM-89,90	1.21	0.75	0.77	1.40	0.76	1.08		
TRITIUM	N/A	395.21	9118.35	454.00	724.43	2464.18		
URANIUM-233,234	1.46	2.64	93.12	1.58	3.97	3.22		
URANIUM-235	0.11	0.11	3.39	0.14	0.16	0.19		
URANIUM-238	1.60	1.49	66.29	1.56	3.46	3.07		

(1) Based on Background Geochemical Characterization Report (DOE 1993) and Rock Creek Surface Soil

ATTACHMENT 3
MAPS OF SUPPORTING DATA

ATTACHMENT 3
LIST OF FIGURES

FIGURE AT3-1	VOLATILE ORGANIC COMPOUNDS (IHSSs 166 1-166 3) SUBSURFACE SOILS
FIGURE AT3-2	ORGANIC COMPOUNDS AREA 1 (UNNAMED TRIBUTARY DRAINAGE) UHSU GROUNDWATER
FIGURE AT3-3	SPECIFIC VOCs 2-BUTANONE, METHYLENE CHLORIDE, AND TOLUENE (IHSSs 167 1 AND 167 3) SUBSURFACE SOILS
FIGURE AT3-4	SPECIFIC ORGANIC COMPOUNDS ACETONE AND METHYLENE CHLORIDE AREA 1 (UNNAMED TRIBUTARY DRAINAGE) UHSU GROUNDWATER
FIGURE AT3-5	ORGANIC COMPOUNDS AREA 2 (NORTH WALNUT CREEK DRAINAGE) UHSU GROUNDWATER
FIGURE AT3-6	METHYLENE CHLORIDE AREA 2 (NORTH WALNUT CREEK DRAINAGE) UHSU GROUNDWATER
FIGURE AT3-7	CHLOROFORM AND TRICHLOROETHENE AREA 2 (NORTH WALNUT CREEK DRAINAGE) UHSU GROUNDWATER
FIGURE AT3-8	SPECIFIC ORGANIC COMPOUNDS 2-BUTANONE, ACETONE, BIS(2-ETHYLHEXYL)PHTHALATE, BUTYL BENZYL PHTHALATE, DI-n-OCTYL PHTHALATE, METHYLENE CHLORIDE, AND TOLUENE (IHSSs 142 1-142 4) POND SEDIMENTS
FIGURE AT3-9	ORGANIC COMPOUNDS AND PESTICIDES/PCBs (IHSSs 142 1-142 4) POND SEDIMENTS
FIGURE AT3-10	ORGANIC COMPOUNDS AREA 3 (SOUTH WALNUT CREEK DRAINAGE) UHSU GROUNDWATER
FIGURE AT3-11	UNFILTERED METALS AREA 3 (SOUTH WALNUT CREEK DRAINAGE) UHSU GROUNDWATER
FIGURE AT3-12	SPECIFIC ORGANIC COMPOUNDS 2-BUTANONE, ACETONE, BIS(2-ETHYLHEXYL)PHTHALATE, BUTYL BENZYL PHTHALATE, DI-n-BUTYL PHTHALATE, METHYLENE CHLORIDE, TOLUENE (IHSSs 142 5-142 9)
FIGURE AT3-13	ORGANIC COMPOUNDS AND PESTICIDES/PCBs (IHSSs 142 5-142 9) PONDS SEDIMENTS 0'-2' DEPTH
FIGURE AT3-14	ORGANIC COMPOUNDS AND PESTICIDES/PCBs (IHSSs 142 5-142 9) PONDS SEDIMENTS 2'-4' DEPTH
FIGURE AT3-15	ANALYTE ABBREVIATIONS, LABORATORY AND VALIDATION QUALIFIERS



EXPLANATION

PONDS/LAKES

OU6 IHSS S

PROTECTED AREA BOUNDARY

OU6 HISTORICAL IHSS BOUNDARY
FOR IHSSs 141 142 5 142 9
143 AND 156 2

- 141 SLUDGE DISPERSAL AREA
- 142 PONDS
- 143 OLD OUTFALL
- 156 2 SOIL DUMP AREA
- 165 TRIANGLE AREA
- 166 1-166 3 TRENCHES A, B C
- 167 1 SPRAY FIELD
- 216 1 EAST SPRAY FIELDS

IHSS LOCATIONS SHOWN ARE BASED
ON REVISED INTERPRETATIONS IN
HISTORICAL RELEASE REPORT DOE
JUNE 1992b

U S DEPARTMENT OF ENERGY
Rocky Flats Golden Colorado

OPERABLE UNIT NO 6
CDPHE CONSERVATIVE SCREEN

AREAS OF CONCERN
WITHIN OPERABLE UNIT NO 6

EXPLANATION

PONDS/LAKES

OU6 IHSS S

PROTECTED AREA BOUNDARY

OU6 HISTORICAL IHSS BOUNDARY
FOR IHSSs 141 142 5 142 9
143 AND 156 2

141 SLUDGE DISPERSAL AREA

142 PONDS

143 OLD OUTFALL

156 2 SOIL DUMP AREA

165 TRIANGLE AREA

166 1-166 3 TRENCHES A, B C

167 1 SPRAY FIELD

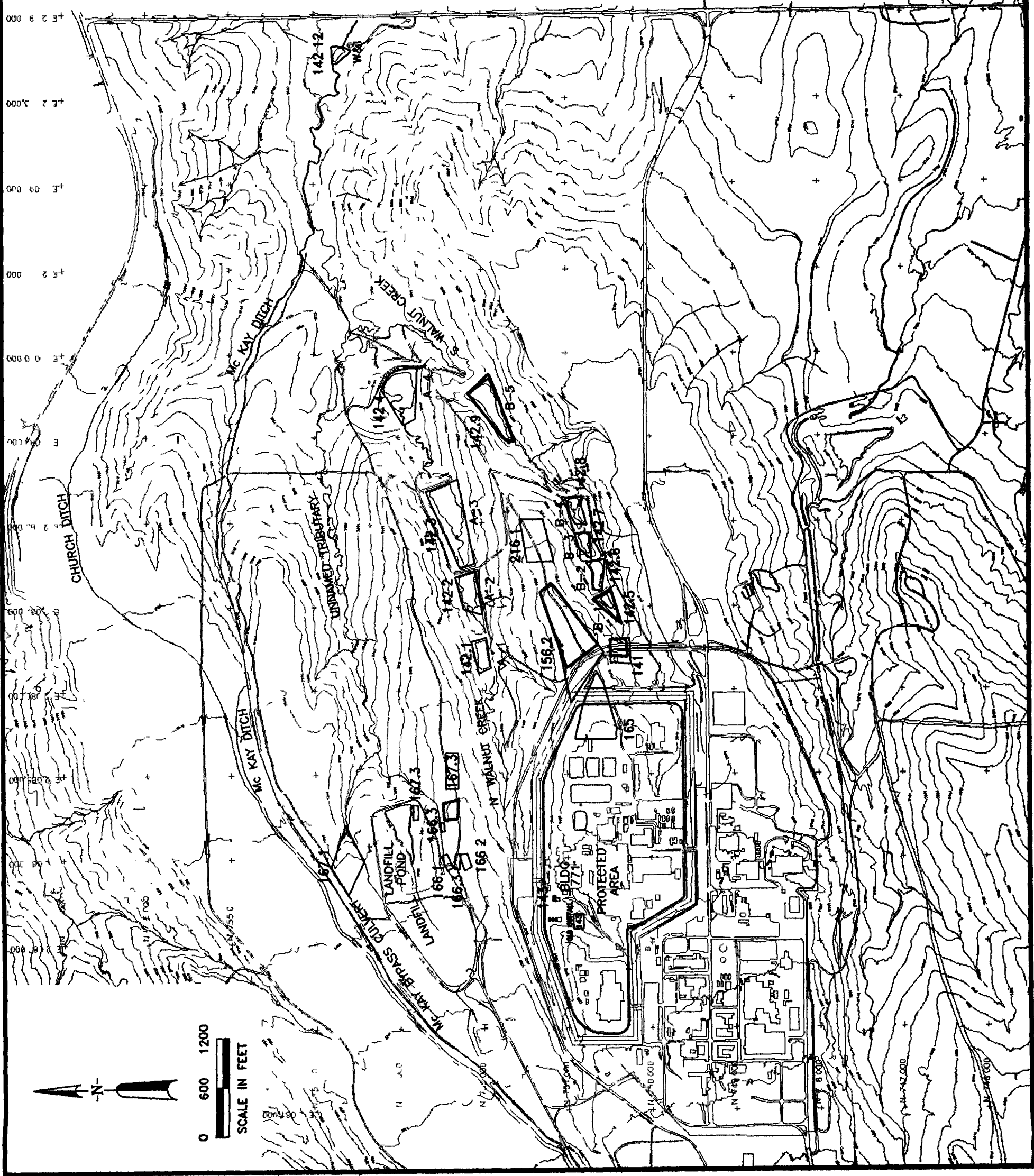
216 1 EAST SPRAY FIELDS

IHSS LOCATIONS SHOWN ARE BASED
ON REVISED INTERPRETATIONS IN
HISTORICAL RELEASE REPORT DOE
JUNE 1992b

U S DEPARTMENT OF ENERGY
Rocky Flats Golden Colorado

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INDIVIDUAL HAZARDOUS
SUBSTANCE SITES
WITHIN OPERABLE UNIT NO 6



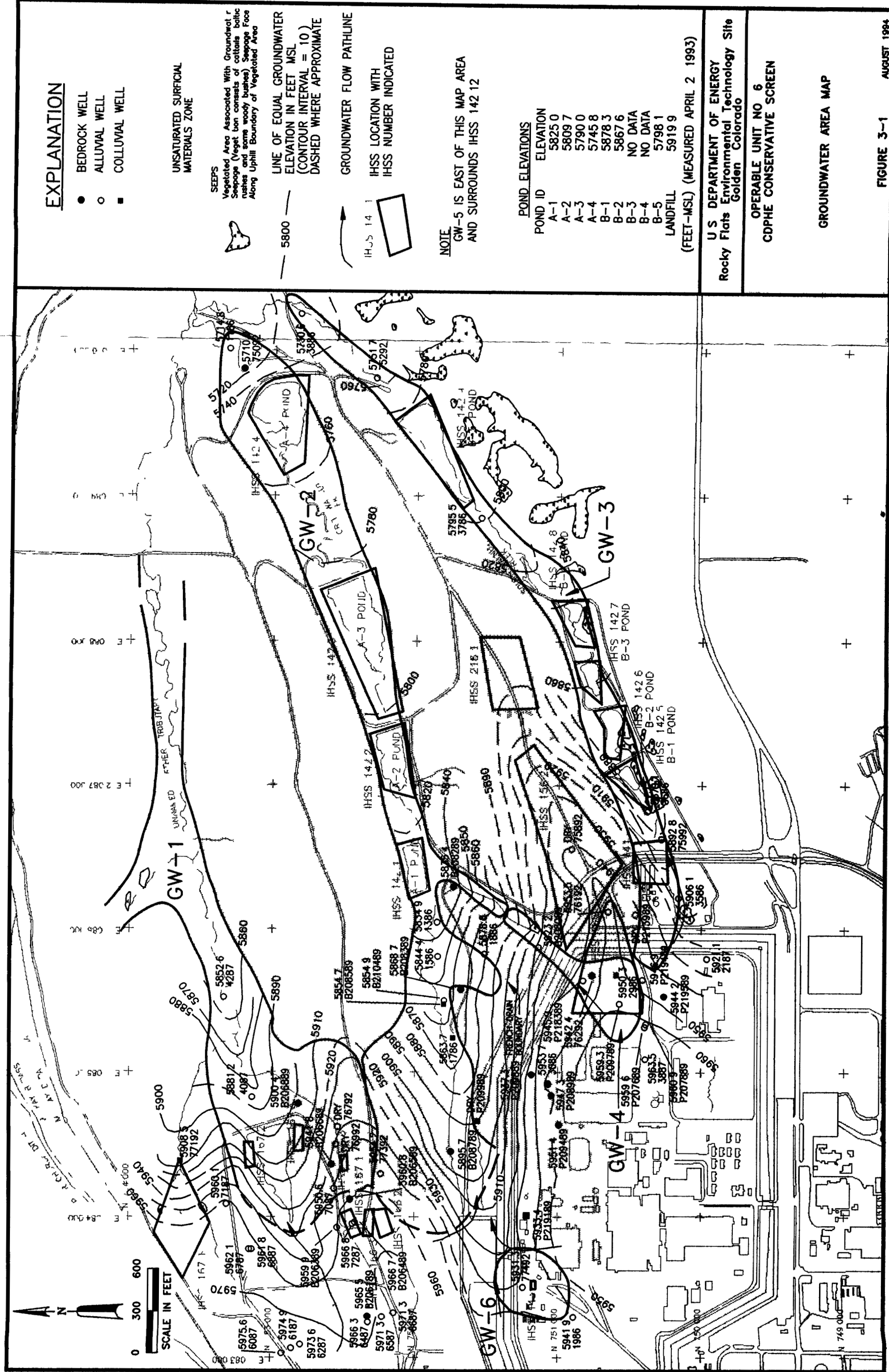
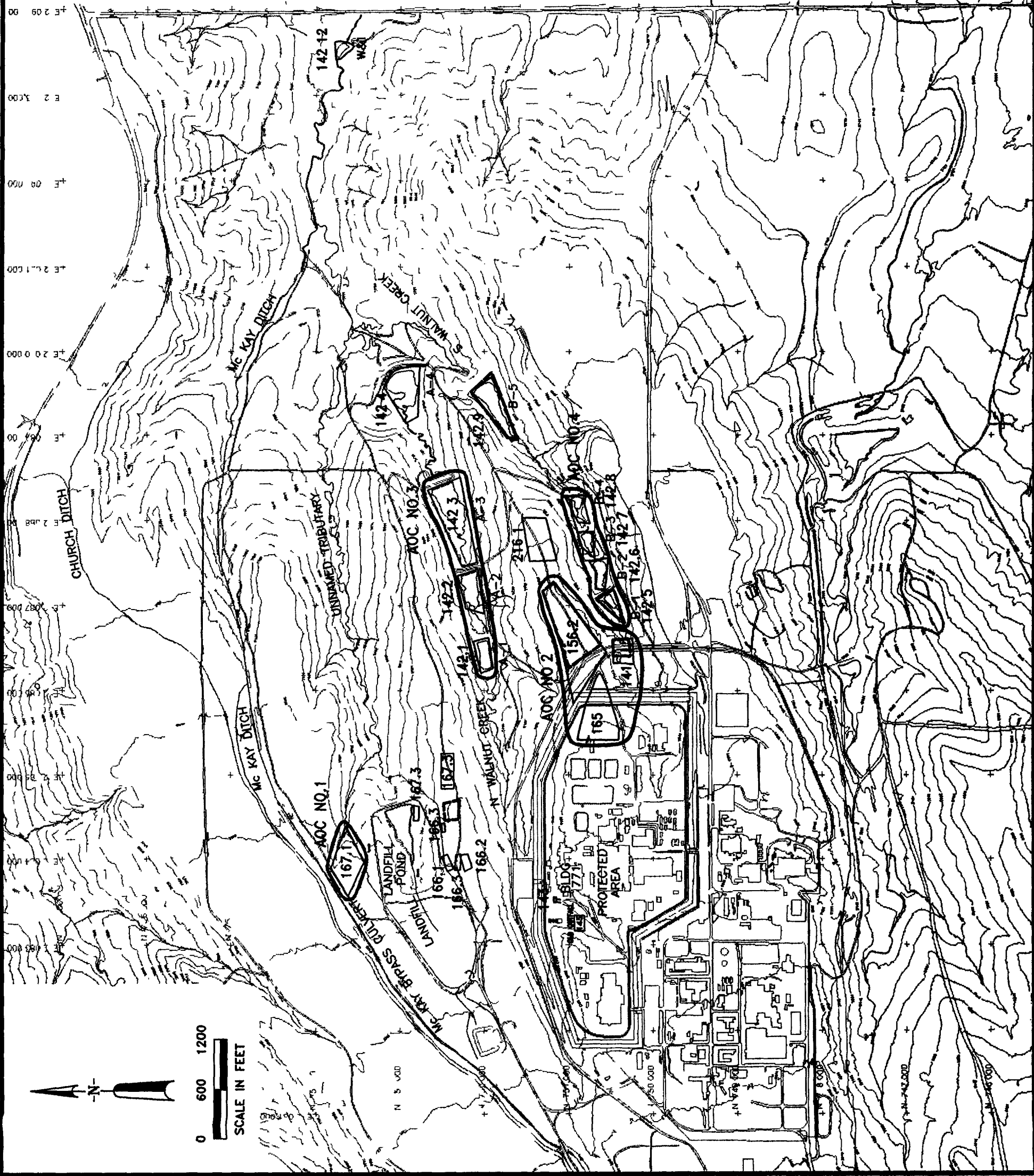


FIGURE 3-1



EXPLANATION

PONDS/LAKES

OU6 IHSS S
142 12

PROTECTED AREA BOUNDARY

OU6 HISTORICAL IHSS BOUNDARY
FOR IHSSs 141 142 5 142 9
143 AND 156 2

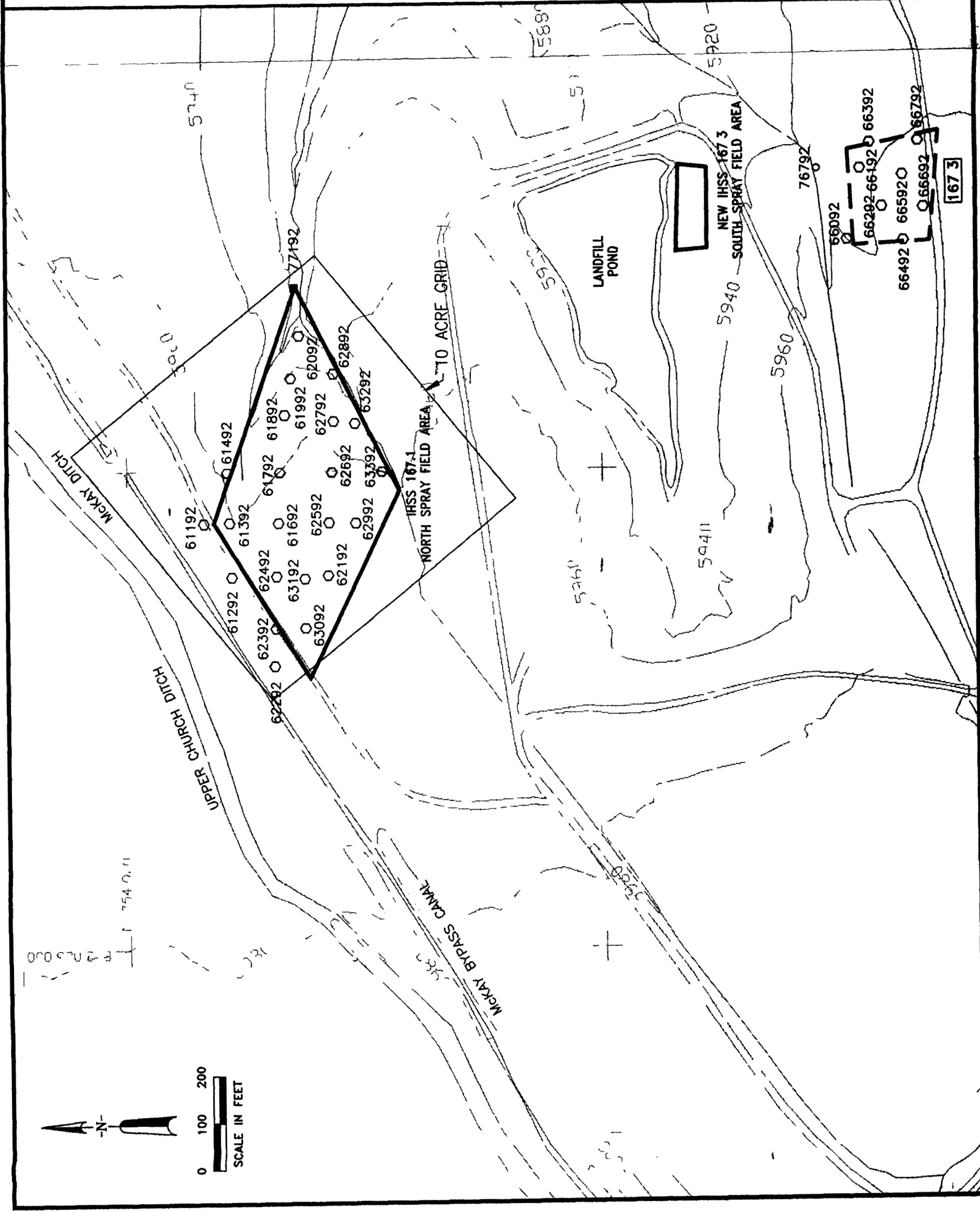
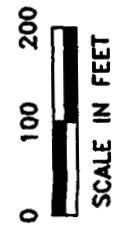
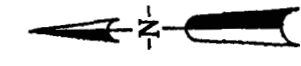
- 141 SLUDGE DISPERSAL AREA
- 142 PONDS
- 143 OLD OUTFALL
- 156 2 SOIL DUMP AREA
- 165 TRIANGLE AREA
- 166 1-166 3 TRENCHES A, B C
- 167 1 SPRAY FIELD
- 216 1 EAST SPRAY FIELDS

IHSS LOCATIONS SHOWN ARE BASED
ON REVISED INTERPRETATIONS IN
HISTORICAL RELEASE REPORT DOE
JUNE 1992b

U S DEPARTMENT OF ENERGY
Rocky Flats Golden Colorado

OPERABLE UNIT NO 6
CDPHE CONSERVATIVE SCREEN

AREAS OF CONCERN
WITHIN OPERABLE UNIT NO 6



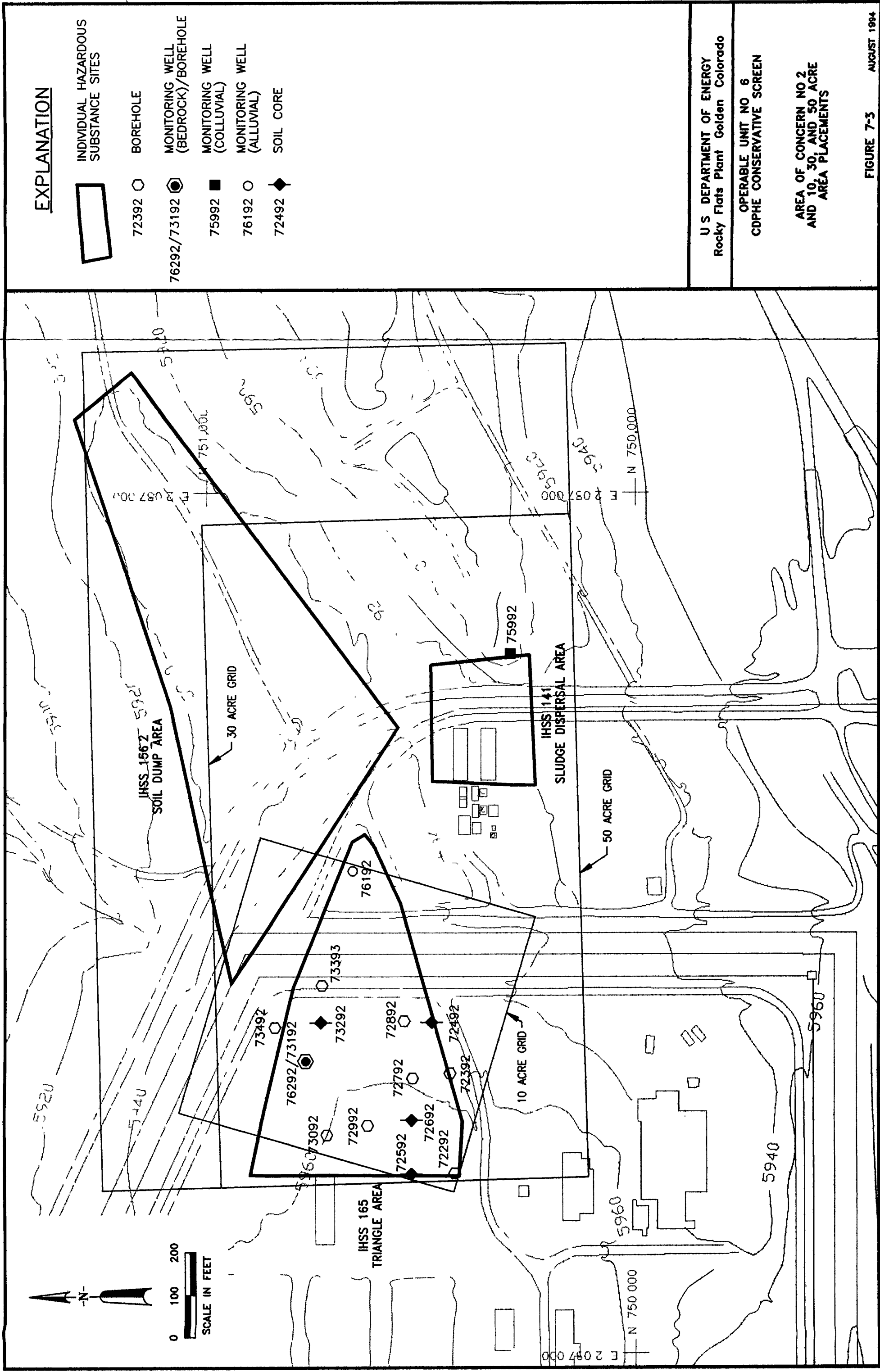
EXPLANATION

- INDIVIDUAL HAZARDOUS SUBSTANCE SITES
- HISTORICAL IHSS BOUNDARIES DOE 1987
- BOREHOLE
- MONITORING WELL (COLLUVIAL)
- MONITORING WELL (ALLUVIAL)

U S DEPARTMENT OF ENERGY
Rocky Flats Plant Golden Colorado

OPERABLE UNIT NO 6
PHASE I RFI/RI REPORT

AREA OF CONCERN NO 1
AND 10 ACRE GRID PLACEMENT



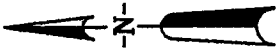
EXPLANATION

- INDIVIDUAL HAZARDOUS SUBSTANCE SITES
- BOREHOLE
- MONITORING WELL (BEDROCK)/BOREHOLE
- MONITORING WELL (COLLUVIAL)
- MONITORING WELL (ALLUVIAL)
- SOIL CORE

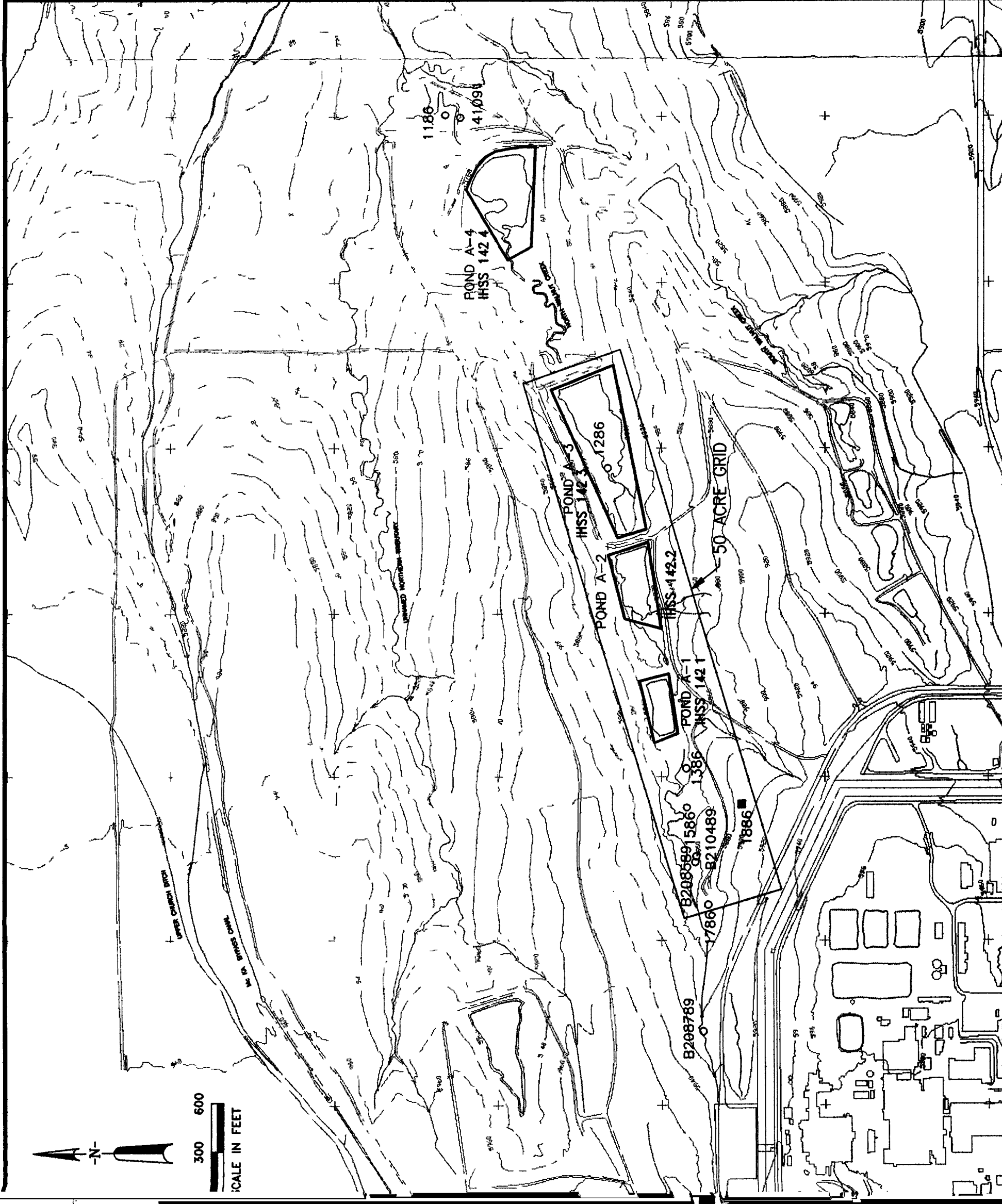
U S DEPARTMENT OF ENERGY
Rocky Flats Plant Golden Colorado

OPERABLE UNIT NO 6
CDPHE CONSERVATIVE SCREEN

AREA OF CONCERN NO 2
AND 10, 30, AND 50 ACRE
AREA PLACEMENTS



300 600
SCALE IN FEET



EXPLANATION

- INDIVIDUAL HAZARDOUS SUBSTANCE SITES
- 1186 ○ MONITORING WELL (ALLUVIAL)
- 1886 ■ MONITORING WELL (COLLUVIAL)
- UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

U S DEPARTMENT OF ENERGY
Rocky Flats Golden Colorado

OPERABLE UNIT NO 6
TECHNICAL MEMORANDUM NO 4

AREA OF CONCERN NO 3
AND 50 ACRE GRID PLACEMENT

EXPLANATION

INDIVIDUAL HAZARDOUS
SUBSTANCE SITES



3586 ○
MONITORING WELL
(ALLUVIAL)

02691 ●
MONITORING WELL
(BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC
UNIT

U S DEPARTMENT OF ENERGY
Rocky Flats Plant Golden Colorado

OPERABLE UNIT NO 6
CDPHE CONSERVATIVE SCREEN

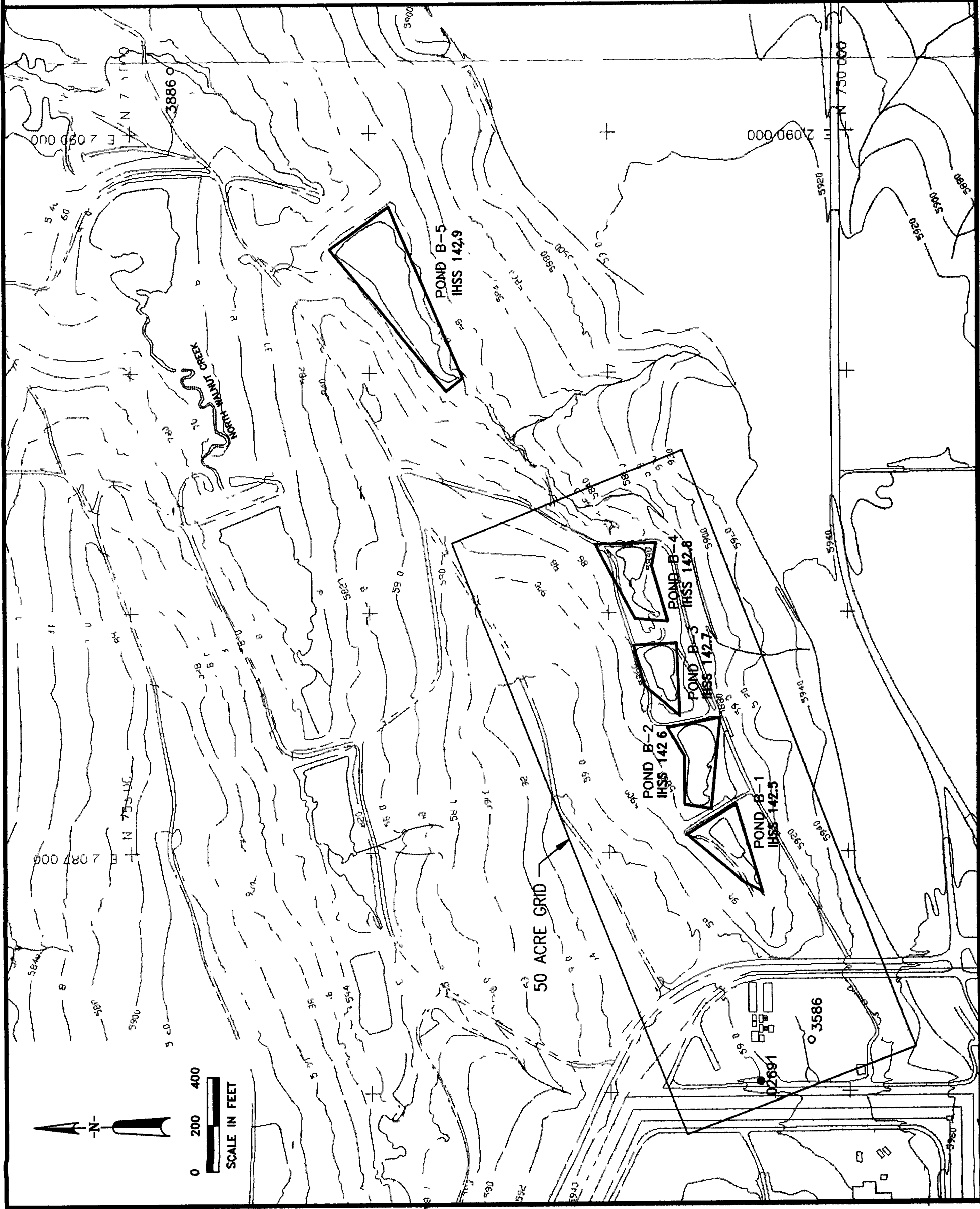
AREA OF CONCERN NO 4
AND 50 ACRE GRID PLACEMENT

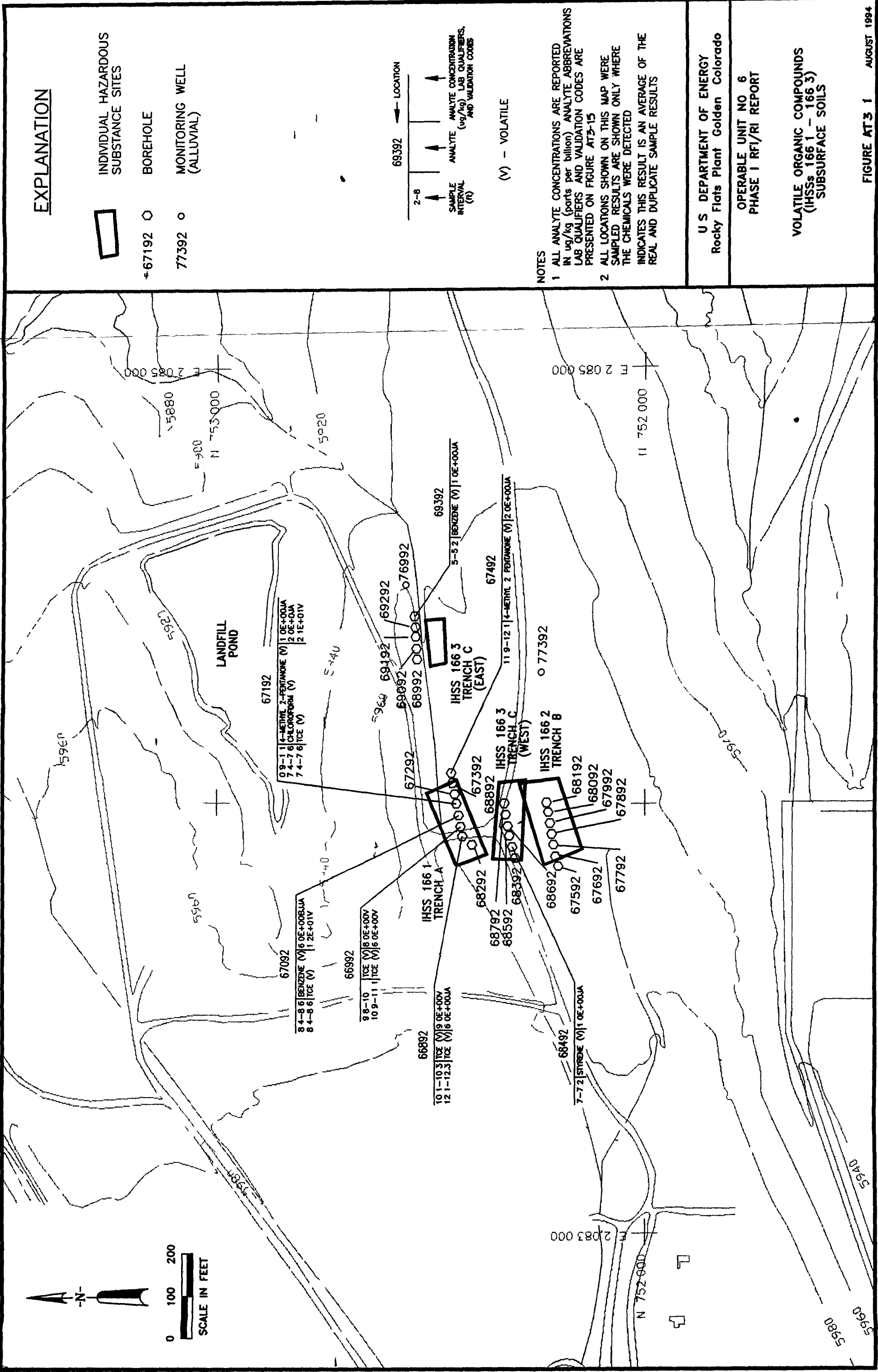
FIGURE 7-5

AUGUST 1994

10/27/94

0068239 1-400





EXPLANATION

INDIVIDUAL HAZARDOUS
SUBSTANCE SITES



MONITORING WELL
(ALLUVIAL)

0586

MONITORING WELL
(BEDROCK)

B206889

UHSU = UPPER HYDROSTRATIGRAPHIC
UNIT

0586

2/26/92

ANALYTE

ANALYTE CONCENTRATION
(ug/l) LAB QUALIFIERS
AND VALIDATION CODES

(V) - VOLATILE

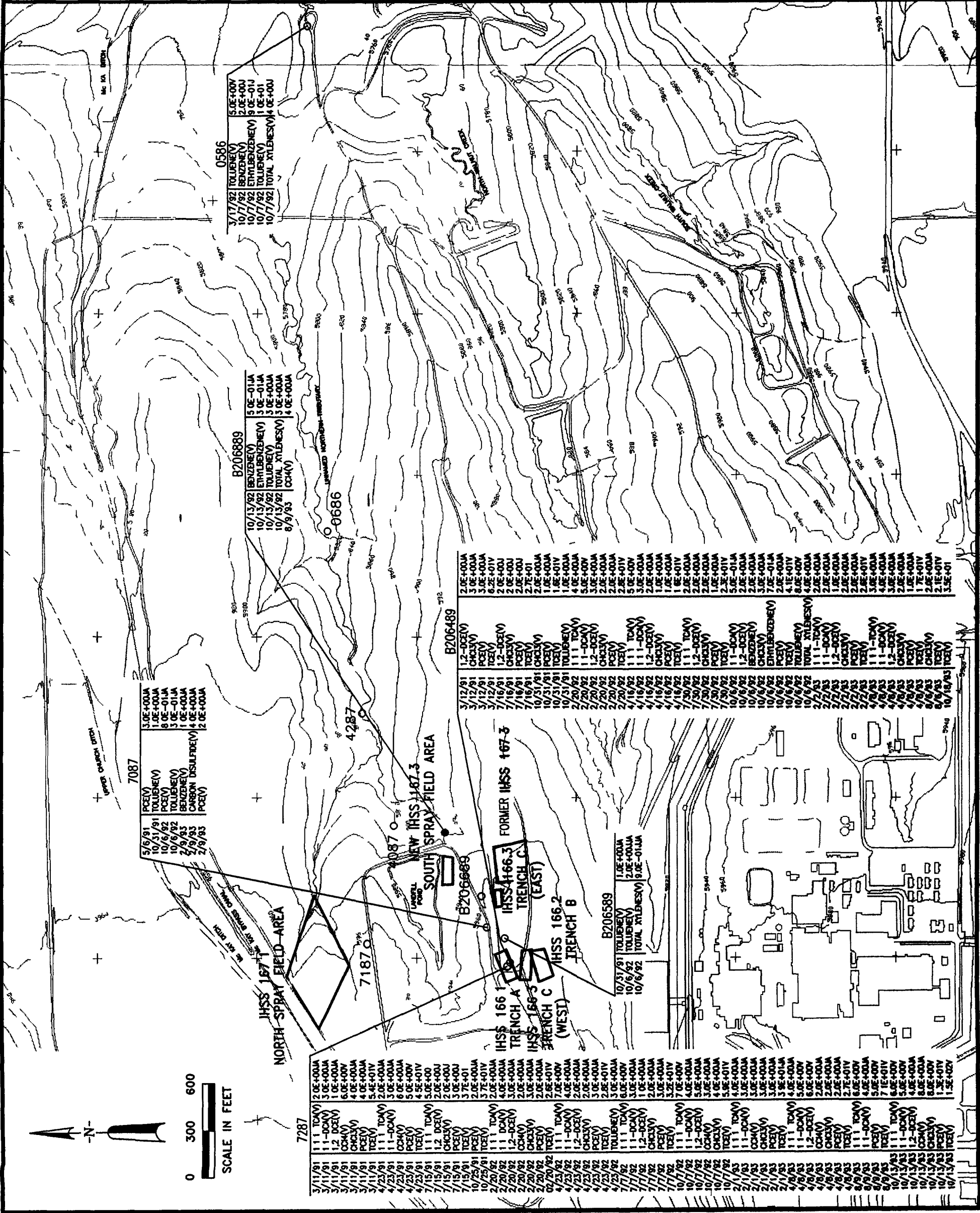
NOTES

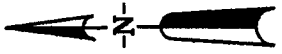
- 1 ALL ANALYTE CONCENTRATIONS ARE REPORTED
IN ug/l (parts per billion) ANALYTE ABBREVIATIONS
LAB QUALIFIERS AND VALIDATION CODES ARE
PRESENTED ON FIGURE AT3 15
- 2 ALL LOCATIONS SHOWN ON THIS MAP WERE
SAMPLED RESULTS ARE SHOWN ONLY WHERE
THE CHEMICALS WERE DETECTED
- * INDICATES THIS RESULT IS AN AVERAGE OF THE
REAL AND DUPLICATE SAMPLE RESULTS

U. S. DEPARTMENT OF ENERGY
Rocky Flats Plant Golden Colorado

OPERABLE UNIT NO 6
PHASE I RF/RI REPORT

ORGANIC COMPOUNDS
AREA 1 (UNNAMED TRIBUTARY DRAINAGE)
USHU GROUNDWATER
1st QUARTER 1991 - 4th QUARTER 1993



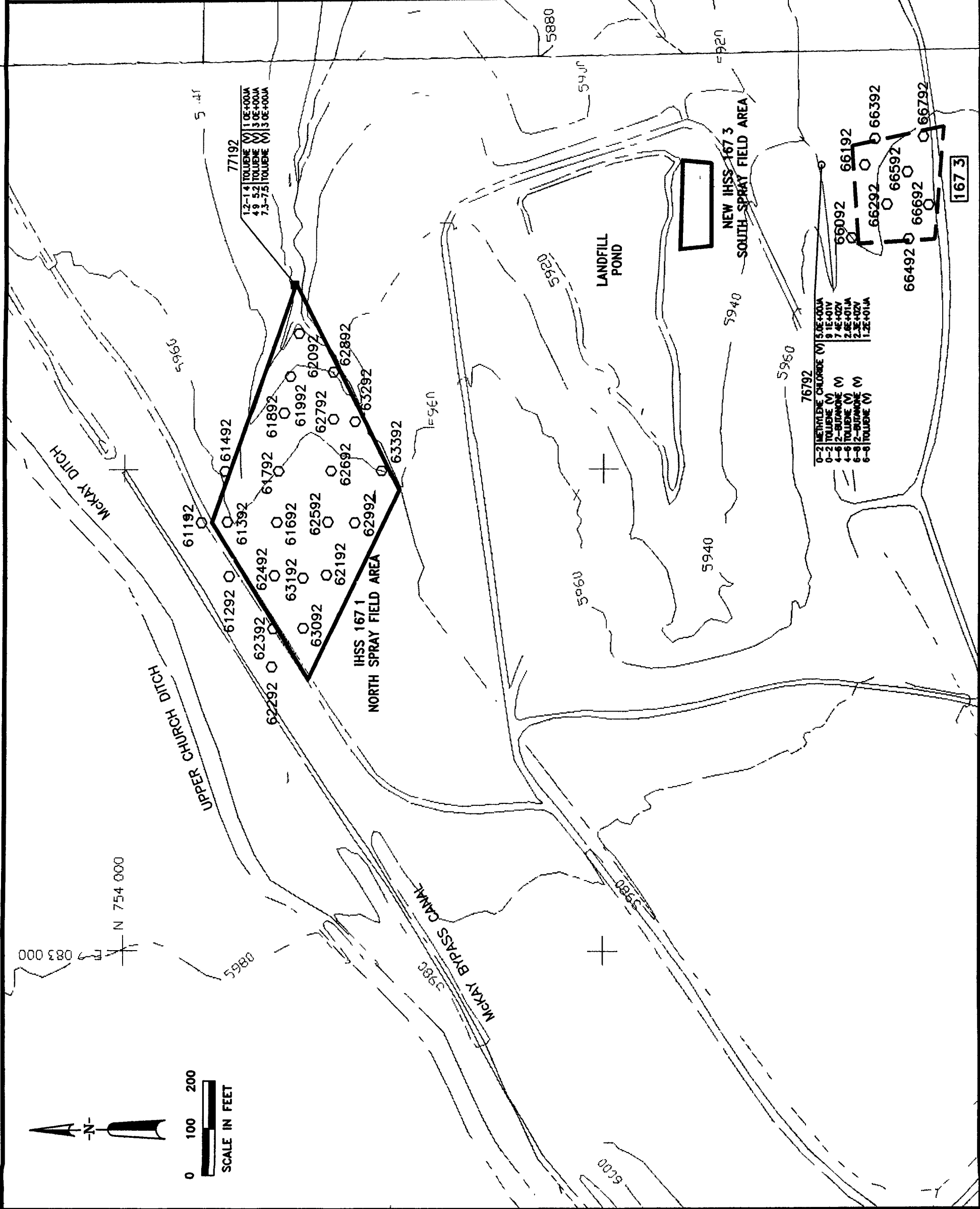


N 754 000

F 083 000



SCALE IN FEET

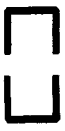


EXPLANATION

INDIVIDUAL HAZARDOUS
SUBSTANCE SITES



HISTORICAL IHSS
BOUNDARIES DOE 1987



167 3

BOREHOLE



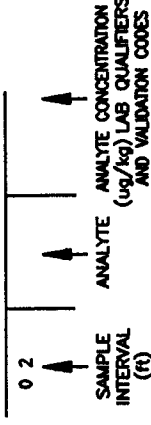
MONITORING WELL
(COLLUVIAL)



MONITORING WELL
(ALLUVIAL)



77192 LOCATION



(V) - VOLATILE

NOTES

- 1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion) ANALYTE ABBREVIATIONS LAB QUALIFIERS AND VALIDATION CODES ARE PRESENTED ON FIGURE AT-3 15
- 2 ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS

U S DEPARTMENT OF ENERGY
Rocky Flats Plant Golden Colorado

OPERABLE UNIT NO 6
PHASE 1 RFI/RI REPORT

SPECIFIC VOCs 2-BUTANONE
METHYLENE CHLORIDE AND TOLUENE
(IHSSs 167 1 AND 167 3)
SUBSURFACE SOILS

FIGURE AT-3 3

AUGUST 1994

4/2/94

OU68076 1-200

EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

**MONITORING WELL
(ALLUVIAL)**

MONITORING WELL
(BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

0586  LOCATION

(V) - VOLATILE

NOTES

1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion) ANALYTE ABBREVIATIONS LAB QUALIFIERS AND VALIDATION CODES ARE PRESENTED ON FIGURE AT 3 15

2 ALL LOCATIONS SHOWN-ON THIS MAP WERE
SAMPLED RESULTS ARE SHOWN ONLY WHERE
THE CHEMICALS WERE DETECTED
INDICATES THIS RESULT IS AN AVERAGE OF THE
REAL AND DUPLICATE SAMPLE RESULTS

**U S DEPARTMENT OF ENERGY
Rocky Flats Plant Golden Colorado**

OPERABLE UNIT NO 6
PHASE I RFI/RI REPORT

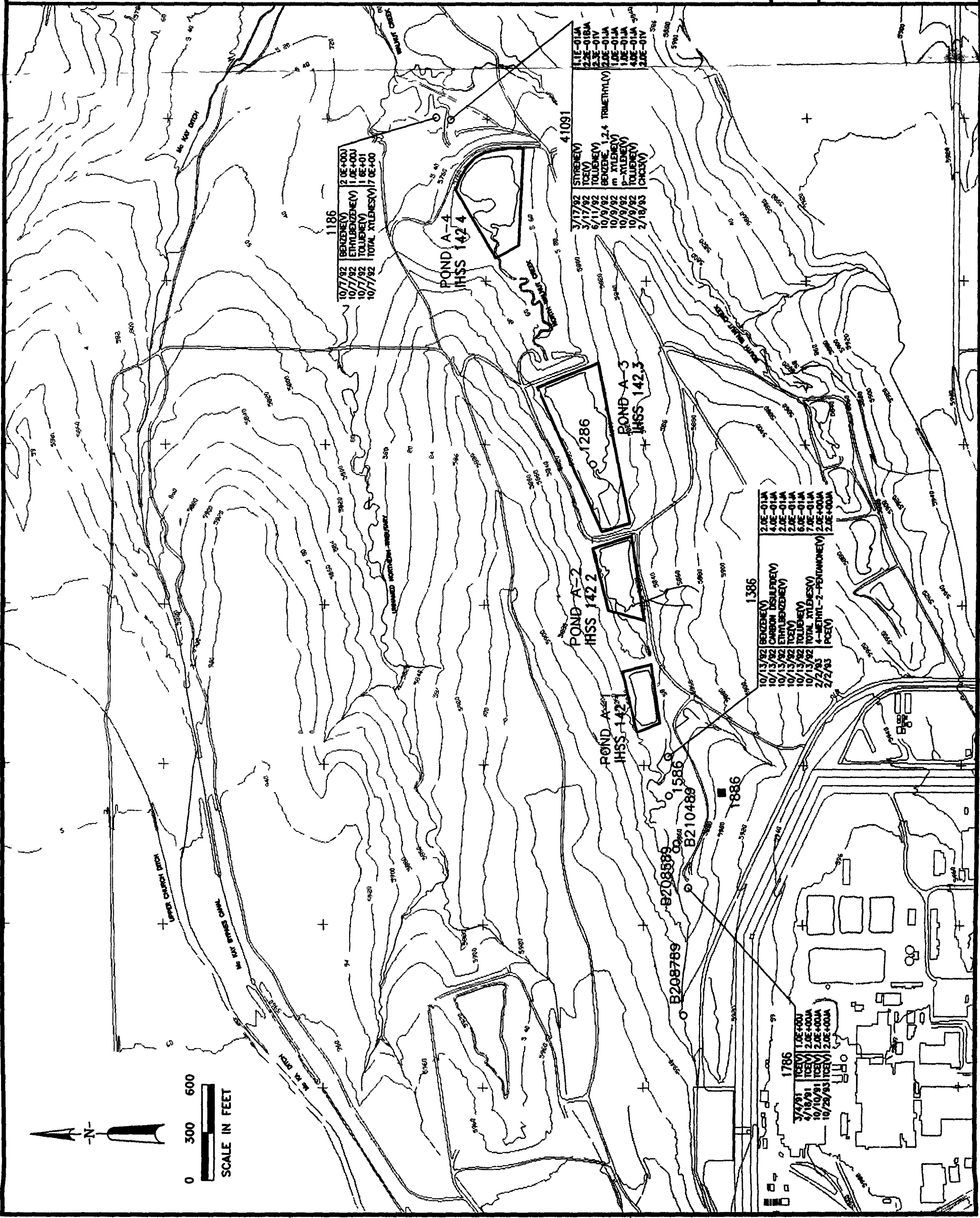
**SPECIFIC ORGANIC COMPOUNDS
ACETONE AND METHYLENE CHLORIDE
AREA 1 (UNNAMED TRIBUTARY DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 - 4th QUARTER 1993**

FIGURE AT 3-4

AUGUST 1994

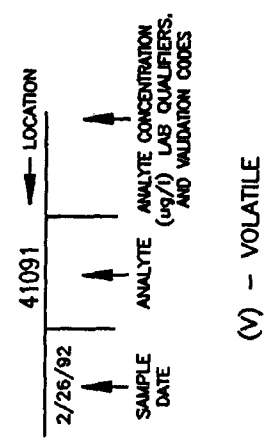
9/7/94

0168144 1-60



EXPLANATION

- INDIVIDUAL HAZARDOUS SUBSTANCE SITES
- MONITORING WELL (ALLUVIAL)
- MONITORING WELL (COLLUVIAL)
- UHSU = UPPER HYDROSTRATIGRAPHIC UNIT



NOTES

- 1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion) ANALYTE ABBREVIATIONS LAB QUALIFIERS AND VALIDATION CODES ARE PRESENTED ON FIGURE AT 3 15
- 2 ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED
- 3 PESTICIDE/PCB ANALYSES WERE PERFORMED ONLY AT LOCATION 41091

INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS

U S DEPARTMENT OF ENERGY
Rocky Flats Plant Golden Colorado

OPERABLE UNIT NO 6
PHASE 1 RFI/RI REPORT

ORGANIC COMPOUNDS
AREA 2 (NORTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 - 4th QUARTER 1993

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

MONITORING WELL
(ALLUVIAL)

1186 0

MONITORING WELL
(COLLUVIAL)

1886

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

41091 LOCATION
3/17/92 METHYLENE CHLORIDE(V) 11E+00JA

SAMPLE DATE	ANALYTE	ANALYTE CONCENTRATION (g/l) LAB QUALIFIERS AND VALIDATION CODES
1		

(V) - VOLATILE

(SV) - SEMVOLATILE

1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion)

2 ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED

INDICATES THIS RESULT IS AN AVERAGE OF THE
REAL AND DUPLICATE SAMPLE RESULTS

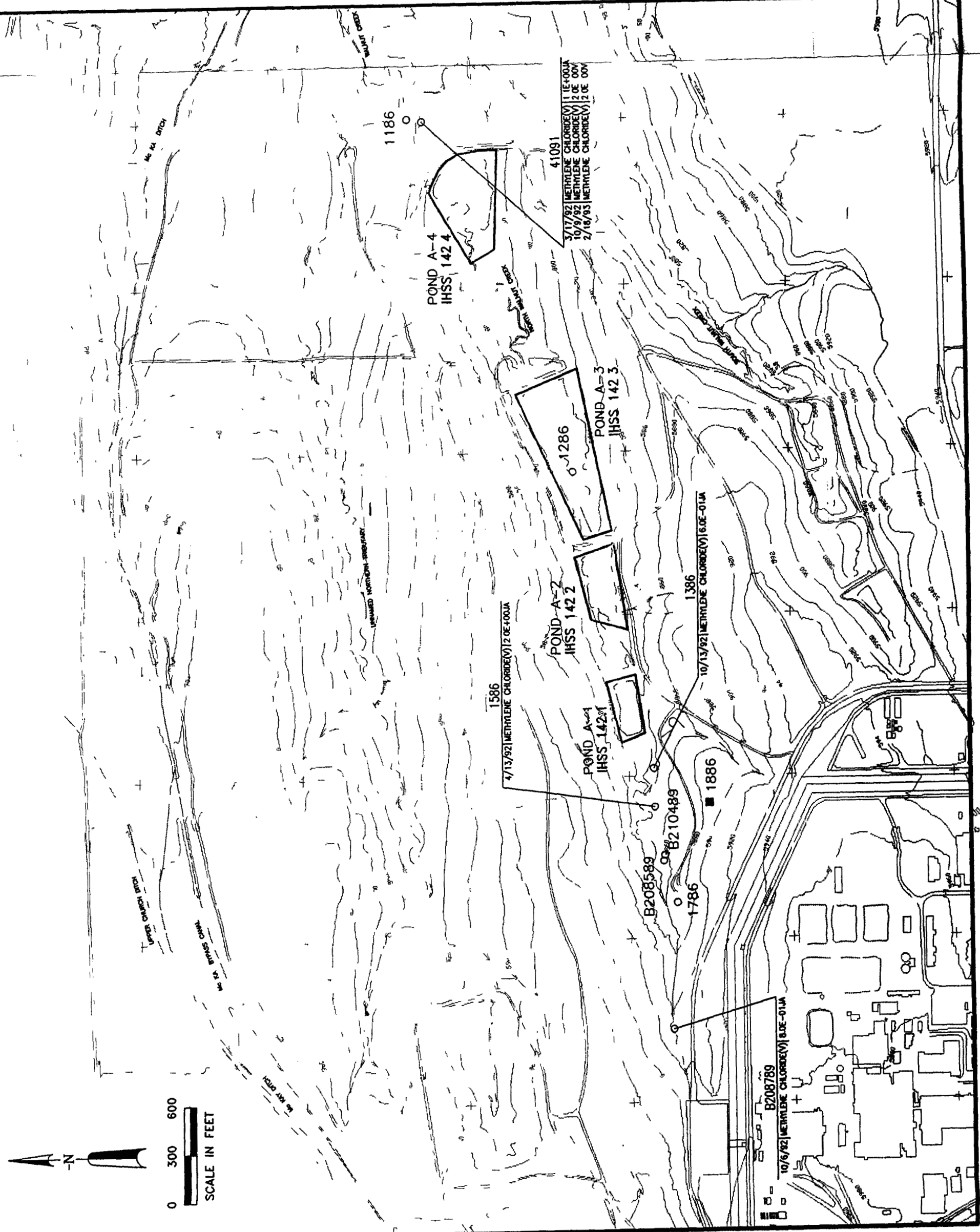
U.S. DEPARTMENT OF ENERGY
Rocky Flats Golden Colorado

OPERABLE UNIT NO 6
TECHNICAL MEMORANDUM NO 4

**METHYLENE CHLORIDE
AREA 2 (NORTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 - 4th QUARTER 1993**

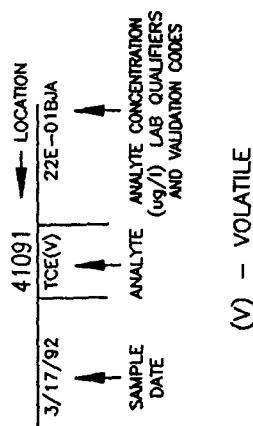
FIGURE AT 3 6 **AUGUST 1994**

CUSTOMER ID: 1-600



EXPLANATION

- INDIVIDUAL HAZARDOUS SUBSTANCE SITES
- 1186 ○ MONITORING WELL (ALLUVIAL)
- 1886 ■ MONITORING WELL (COLLUVIAL)
- UHSU = UPPER HYDROSTRATIGRAPHIC UNIT



NOTES

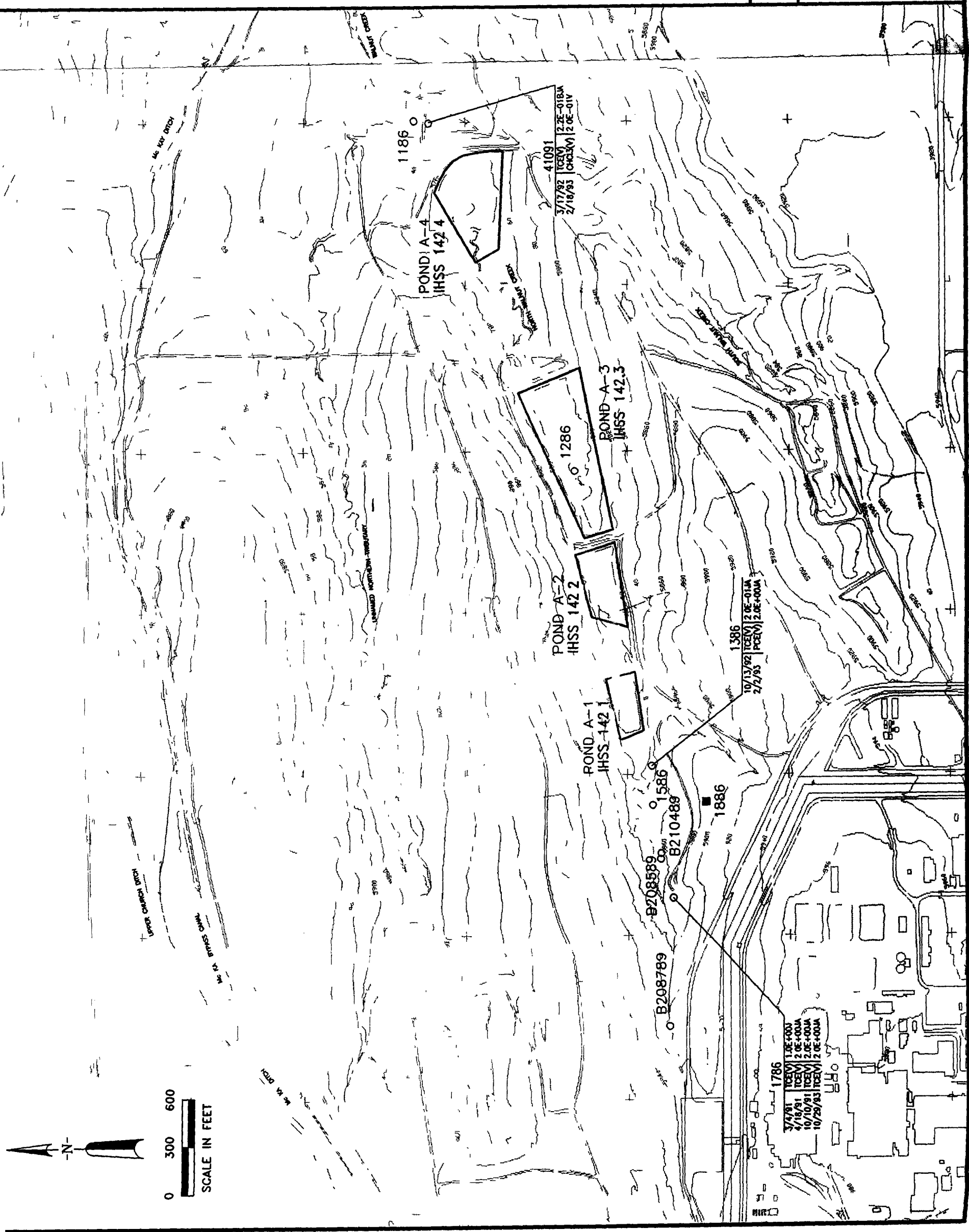
- 1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion)
- 2 ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED
- 3 PESTICIDE/PCB ANALYSES WERE PERFORMED ONLY AT LOCATION 41091

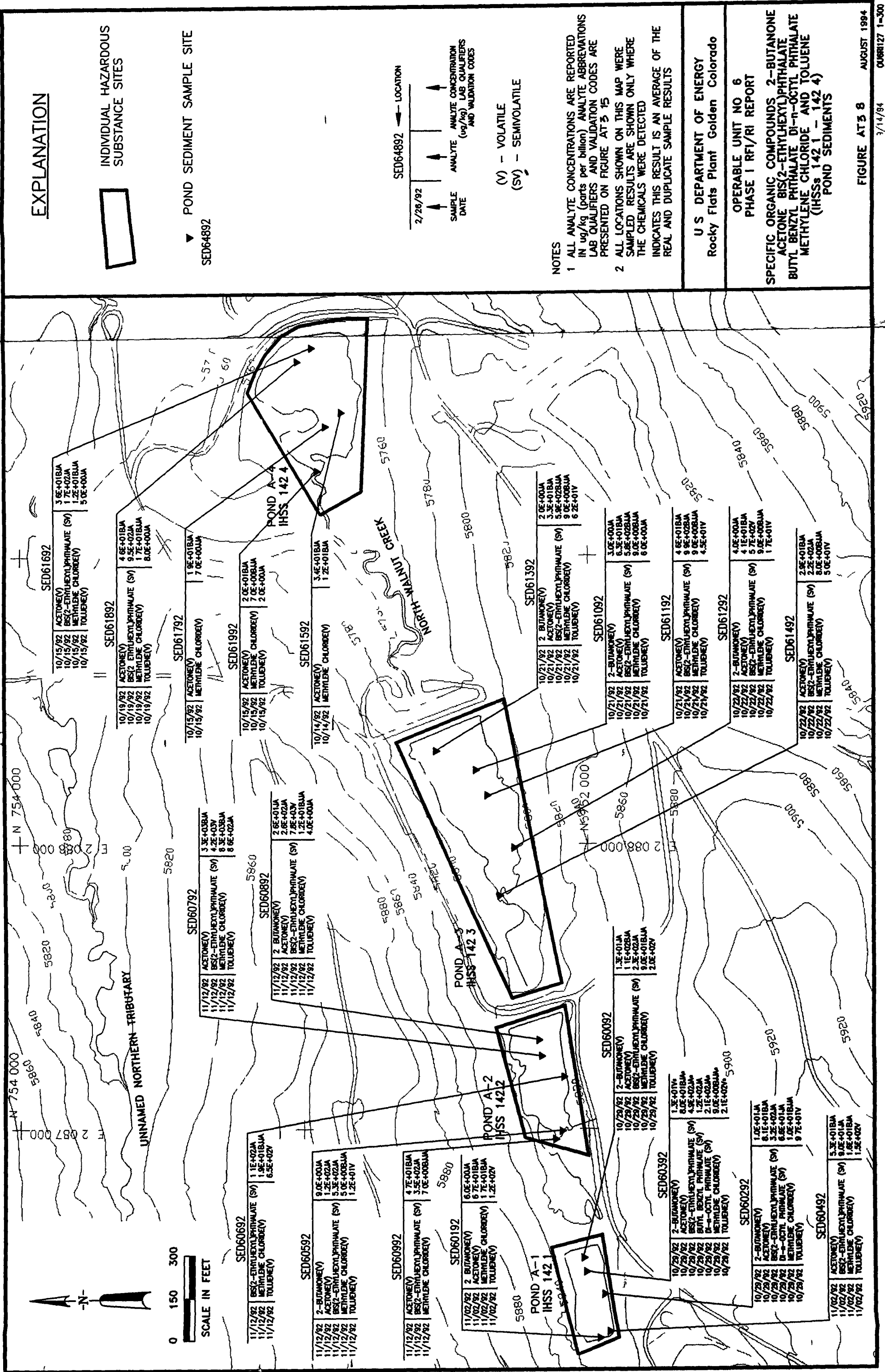
INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS

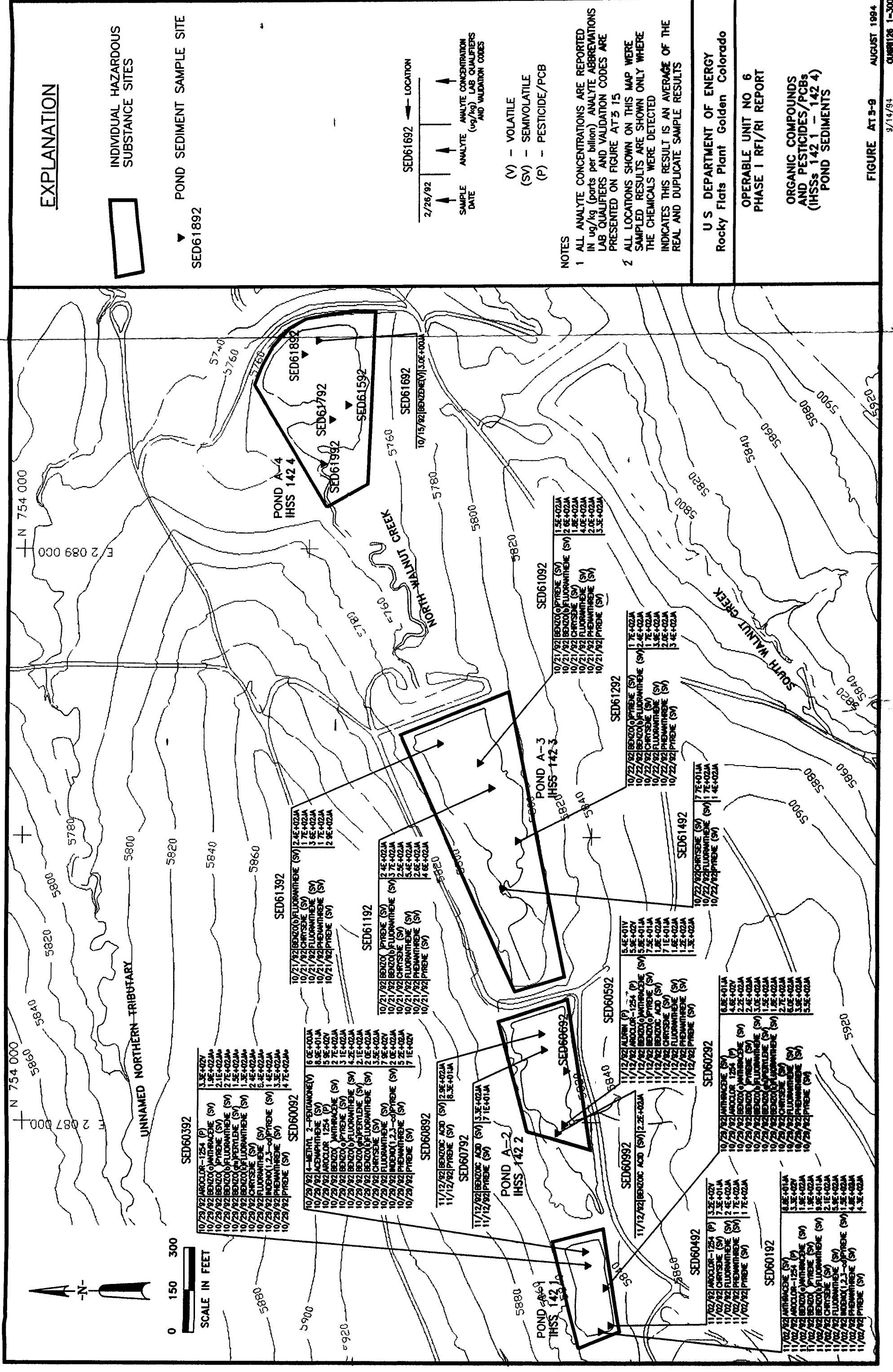
U S DEPARTMENT OF ENERGY
Rocky Flats Golden Colorado

OPERABLE UNIT NO 6
TECHNICAL MEMORANDUM NO 4

CHLOROFORM AND TRICHLOROETHENE
AREA 2 (NORTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 - 4th QUARTER 1993







EXPLANATION

INDIVIDUAL HAZARDOUS
SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED61892

SED61692 ← LOCATION

2/26/92
↑ SAMPLE DATE
↑ ANALYTE
↑ ANALYTE CONCENTRATION
(ug/kg) LAB QUALIFIERS
AND VALIDATION CODES

(V) - VOLATILE
(SV) - SEMIVOLATILE
(P) - PESTICIDE/PCB

NOTES

- 1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion) ANALYTE ABBREVIATIONS LAB QUALIFIERS AND VALIDATION CODES ARE PRESENTED ON FIGURE AT-5 15
- 2 ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED. RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED. INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS

U S DEPARTMENT OF ENERGY
Rocky Flats Plant Golden Colorado

OPERABLE UNIT NO 6
PHASE I RF/RI REPORT

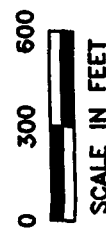
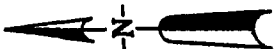
ORGANIC COMPOUNDS
AND PESTICIDES/PCBs
(IHSSs 142.1 - 142.4)
POND SEDIMENTS

FIGURE AT 3-9

AUGUST 1994

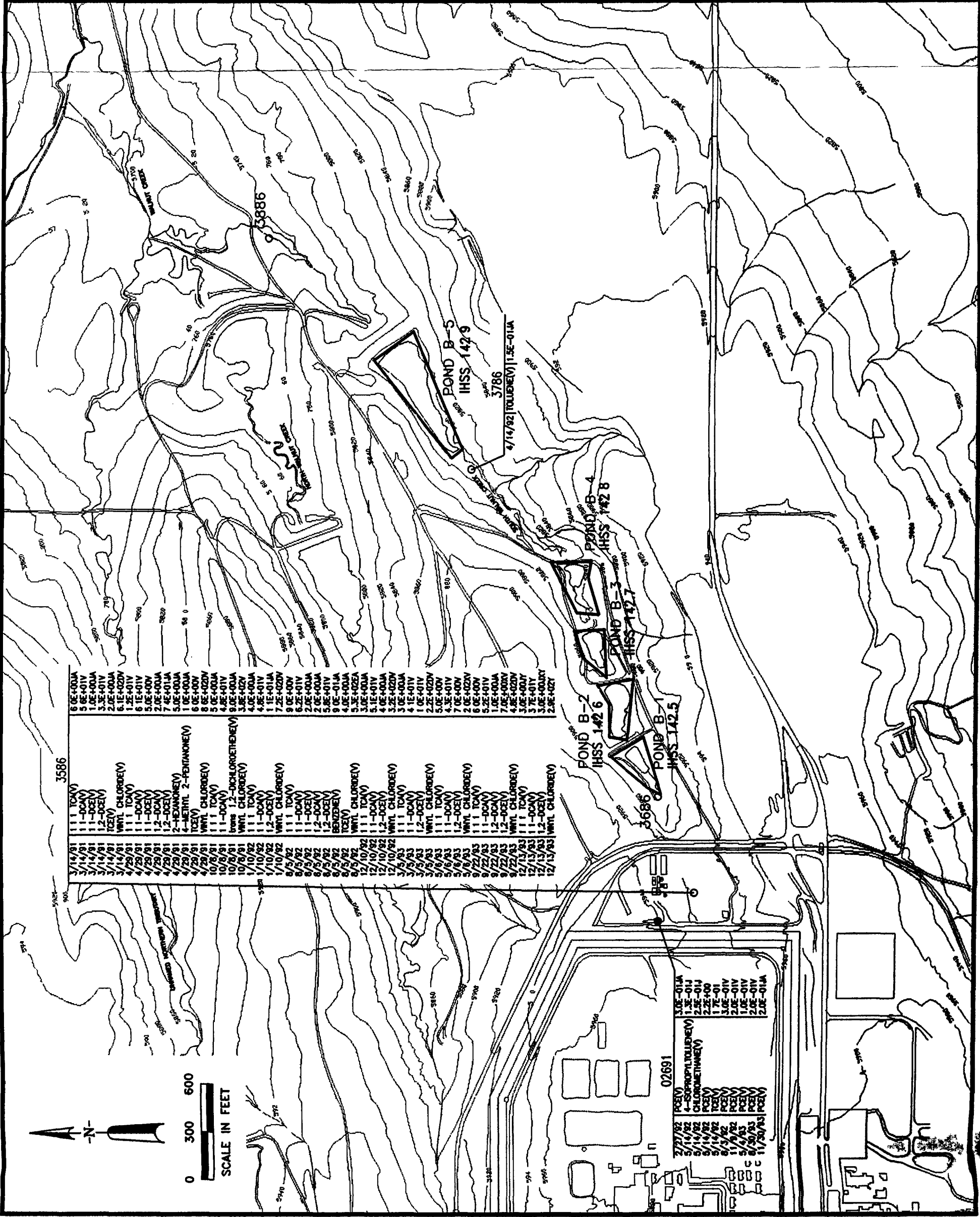
3/14/94

068126 1-300



3/14/91	111 TCNV	6.0E+00A
3/14/91	11-DCNV	5.0E+01V
3/14/91	11-DCNV	1.0E+00A
3/14/91	12-DCNV	3.3E+01V
3/14/91	TCNV	2.0E+00A
3/14/91	VRNL CHLORDE(V)	6.1E+02DV
4/25/91	111 TCNV	1.2E+01V
4/25/91	11-DCNV	6.1E+01V
4/25/91	11-DCNV	5.0E+00V
4/25/91	12-DCNV	2.0E+00A
4/25/91	2-HEXANONE(V)	7.4E+01A
4/25/91	4-HEXANONE(V)	5.0E+00A
4/25/91	TCNV	1.0E+00A
4/25/91	VRNL CHLORDE(V)	6.0E+00V
10/5/91	111 TCNV	8.0E+02DV
10/5/91	11-DCNV	5.0E+00A
10/5/91	VRNL CHLORDE(V)	4.0E+01V
10/5/91	VRNL CHLORDE(V)	3.0E+02V
1/10/92	111 TCNV	4.0E+00A
1/10/92	12-DCNV	1.1E+01A
1/10/92	VRNL CHLORDE(V)	7.2E+02DV
8/5/92	111 TCNV	9.0E+00V
8/5/92	11-DCNV	6.2E+01V
8/5/92	11-DCNV	2.0E+00A
8/5/92	12-DCNV	2.0E+00A
8/5/92	12-DCNV	5.0E+01V
8/5/92	BENZENE(V)	9.0E+01A
8/5/92	TCNV	4.0E+00A
8/5/92	VRNL CHLORDE(V)	5.3E+02A
12/10/92	111 TCNV	3.0E+00A
12/10/92	11-DCNV	3.1E+01V
12/10/92	VRNL CHLORDE(V)	3.2E+02DV
3/5/93	111 TCNV	4.1E+01V
3/5/93	11-DCNV	1.0E+01V
3/5/93	12-DCNV	2.2E+02DV
3/5/93	VRNL CHLORDE(V)	5.0E+00V
3/5/93	111 TCNV	4.3E+01V
3/5/93	12-DCNV	7.0E+00V
3/5/93	VRNL CHLORDE(V)	2.0E+02DV
9/22/93	111 TCNV	6.0E+00V
9/22/93	11-DCNV	5.2E+01V
9/22/93	12-DCNV	1.0E+00A
9/22/93	VRNL CHLORDE(V)	7.0E+02DV
12/13/93	111 TCNV	4.0E+02DV
12/13/93	11-DCNV	3.0E+01V
12/13/93	12-DCNV	3.0E+00V
12/13/93	VRNL CHLORDE(V)	2.0E+02V

2/27/92	PCNV	3.0E-01A
5/14/92	4-ISO-PROP(1)TOLUENE(V)	1.3E-01J
5/14/92	CHLOROMETHANE(V)	2.5E-01J
5/14/92	PCNV	2.2E+00
5/14/92	PCNV	1.7E-01
8/3/92	PCNV	3.0E-01V
1/6/93	PCNV	1.0E-01V
5/6/93	PCNV	2.0E-01V
11/30/93	PCNV	2.0E-01A

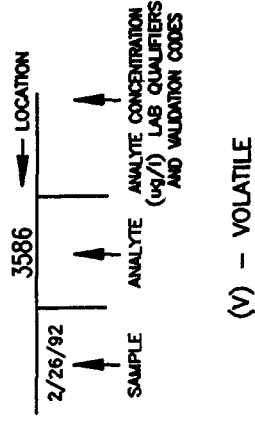


EXPLANATION

INDIVIDUAL HAZARDOUS
SUBSTANCE SITES

- 3586 ○ MONITORING WELL
(ALLUVIAL)
- 02691 ● MONITORING WELL
(BEDROCK)

UHSU = UPPER HYDROSTRATIGRAPHIC
UNIT



NOTES

- 1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/l (parts per billion) ANALYTE ABBREVIATIONS, LAB QUALIFIERS AND VALIDATION CODES ARE PRESENTED ON FIGURE AT-5 15
 - 2 ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED
 - 3 PESTICIDE/PCB ANALYSES WERE PERFORMED AT ONLY LOCATION 02691
- INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS

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Rocky Flats Plant Golden Colorado

OPERABLE UNIT NO 6
PHASE I RFI/RI REPORT

ORGANIC COMPOUNDS
AREA 3 (SOUTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 - 4th QUARTER 1993

INDIVIDUAL HAZARDOUS SUBSTANCE SITES

**MONITORING WELL
(ALLUVIAL)**

**MONITORING WELL
(BEDROCK)**

UHSU = UPPER HYDROSTRATIGRAPHIC UNIT

3686 — LOCATION

01/06/19

1

ANALYTE CONCENTRATION
($\mu\text{g/l}$) LAB QUALIFIERS,
AND VALIDATION CODES

NOTES

1 ALL ANALYTE CONCENTRATIONS ARE REPORTED
IN ug/l (parts per billion) ANALYTE ABBREVIATIONS
LAB QUALIFIERS AND VALIDATION CODES ARE
PRESENTED ON FIGURE A-T3 15

2 ALL LOCATIONS SHOWN ON THIS MAP WERE
SAMPLED RESULTS ARE SHOWN ONLY WHERE
THE CHEMICALS WERE DETECTED ABOVE BACKGROUND
MEAN PLUS 2 STANDARD DEVIATIONS
INDICATES THIS RESULT IS AN AVERAGE OF THE
REAL AND DUPLICATE SAMPLE RESULTS

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UNFILTERED METALS
AREA 3 (SOUTH WALNUT CREEK DRAINAGE)
UHSU GROUNDWATER
1st QUARTER 1991 - 4th QUARTER 1993

FIGURE AT 3 11

7661 1512014

8/29/94

QUESTIONS 1-400

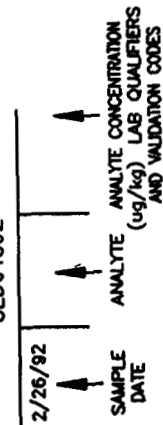
EXPLANATION

INDIVIDUAL HAZARDOUS
SUBSTANCE SITES

POND SEDIMENT SAMPLE SITE

SED63892

SED64392



NOTES

- 1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion) ANALYTE ABBREVIATIONS LAB QUALIFIERS AND VALIDATION CODES ARE PRESENTED ON FIGURE AT 3 15
 - 2 ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED
 - 3 ALL SAMPLES WERE COLLECTED FROM A DEPTH OF 0 TO 2 FEET UNLESS OTHERWISE INDICATED WITH A DEPTH NOTATION BESIDE THE LOCATION CODE
- INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS

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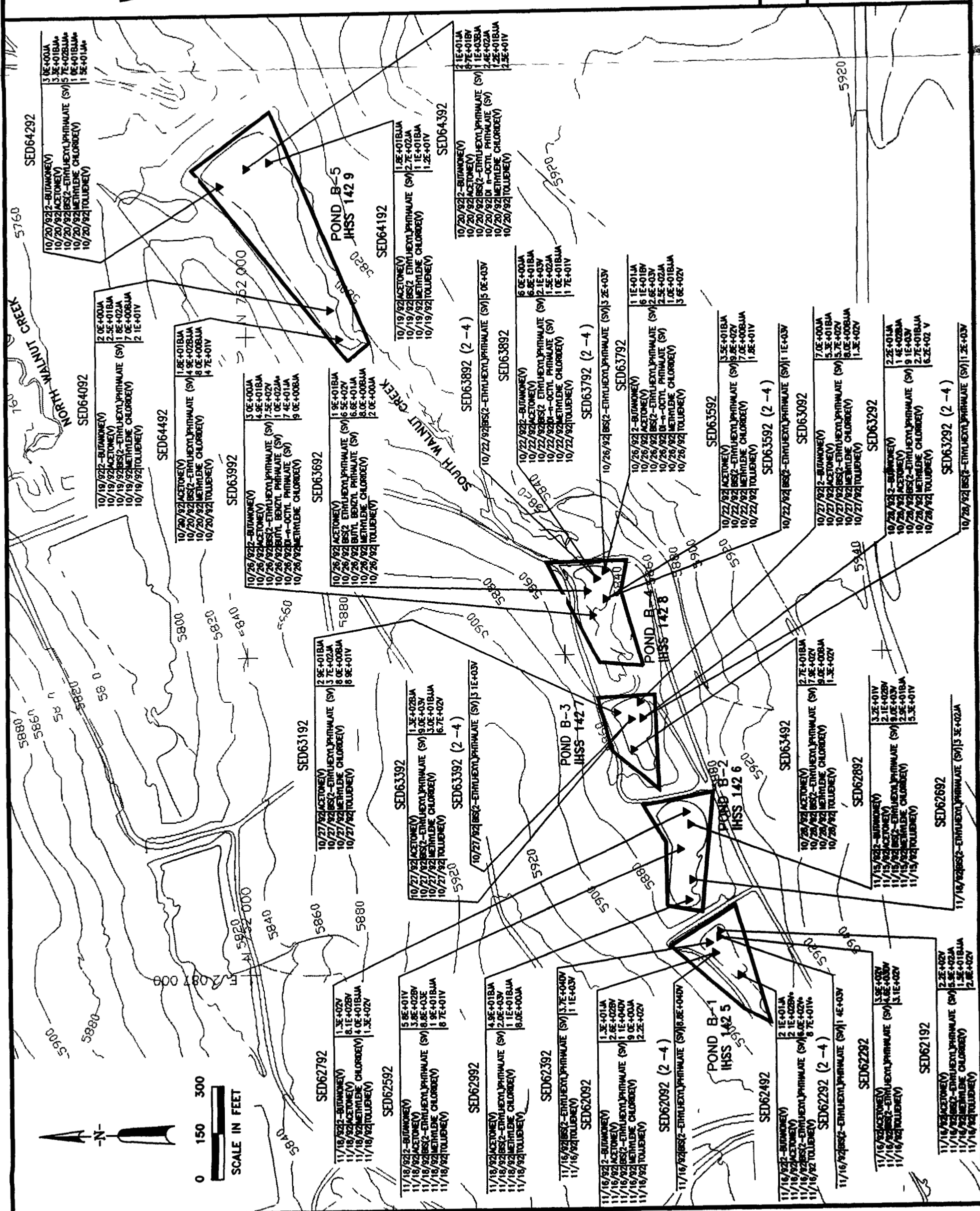
SPECIFIC ORGANIC COMPOUNDS
2-BUTANONE, ACETONE, BIS(2-ETHYLHEXYL)PHTHALATE,
BUTYL BENZYL PHTHALATE, DI-n-OCTYL PHTHALATE,
METHYLENE CHLORIDE, TOLUENE
(IHSSs 142 5 - 142 9)
POND SEDIMENTS

FIGURE AT 3-12

AUGUST 1994

1/14/94

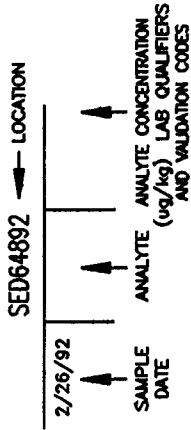
0000129 1-300



EXPLANATION

INDIVIDUAL HAZARDOUS
SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED63692



(V) - VOLATILE
(SV) - SEMIVOLATILE
(P) - PESTICIDES/PCBS

NOTES

- 1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion) ANALYTE ABBREVIATIONS LAB QUALIFIERS AND VALIDATION CODES ARE PRESENTED ON FIGURE AT 3 15
 - 2 ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED ABOVE BACKGROUND MEAN PLUS 2 STANDARD DEVIATIONS
- INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS

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ORGANIC COMPOUNDS
AND PESTICIDES/PCBS
(IHSS 142.5 - 142.9)
POND SEDIMENTS
0 -2 DEPTH

FIGURE AT 3 15

AUGUST 1994

9/15/94

068130 1-300



EXPLANATION

INDIVIDUAL HAZARDOUS
SUBSTANCE SITES

▼ POND SEDIMENT SAMPLE SITE
SED64292

SED64892 ← LOCATION
2/26/92
↑ SAMPLE DATE
↑ ANALYTE CONCENTRATION
(ug/kg) LAB QUALIFIERS
AND VALIDATION CODES

(SV) - SEMIVOLATILE
(P) - PESTICIDES/PCBS

NOTES

- 1 ALL ANALYTE CONCENTRATIONS ARE REPORTED IN ug/kg (parts per billion) ANALYTE ABBREVIATIONS LAB QUALIFIERS AND VALIDATION CODES ARE PRESENTED ON FIGURE AT 3 15
 - 2 ALL LOCATIONS SHOWN ON THIS MAP WERE SAMPLED RESULTS ARE SHOWN ONLY WHERE THE CHEMICALS WERE DETECTED ABOVE BACKGROUND MEAN PLUS 2 STANDARD DEVIATIONS
- INDICATES THIS RESULT IS AN AVERAGE OF THE REAL AND DUPLICATE SAMPLE RESULTS

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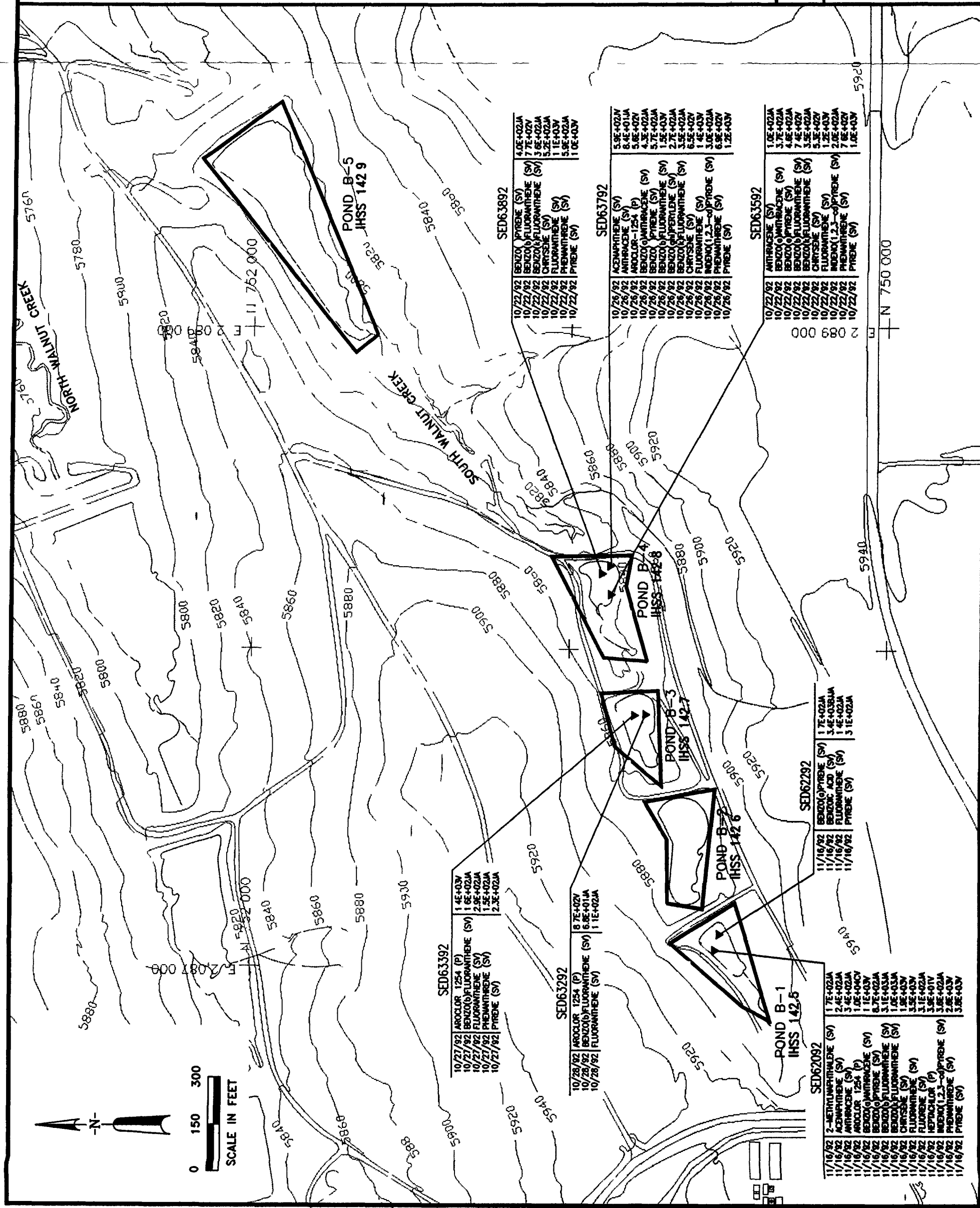
ORGANIC COMPOUNDS
AND PESTICIDES/PCBS
(IHSS 142 5 - 142 9)
POND SEDIMENTS
2 - 4 DEPTH

FIGURE AT 3 14

AUGUST 1994

9/14/94

0068135 1-300



ANALYTE ABBREVIATIONS

VOLATILE ORGANIC COMPOUNDS

1 1 1 2-PCA
1 1 2 2-PCA
1 1 1-PCA
1 1 1-TCA
1 1-DCA
1 1-DCE
1 2-DCA
1 2-DCE
CCl₄
CHCl₃
Cis-1 2-DCE
PCE
TCE

B = ORGANICS (VOLATILES SEMIVOLATILES PESTICIDES) INDICATES
CHEMICAL WAS IN BOTH THE SAMPLE AND METHOD BLANK

B = INORGANIC (METALS & INORGANICS) DETECTED CONCENTRATION
WAS LESS THAN CRQL -

B = RADIONUCLIDES - THE ACTIVITY IN THE METHOD BLANK
EXCEEDED THE MDA

C = PESTICIDE RESULT WHERE IDENTIFICATION WAS CONFIRMED
BY GC/MS

METALS AND OTHER COMPOUNDS

Al
Ag
As
Ba
Be
Ca
Cd
Co
Cr
Cu
Fe
Hg
K
Li
Mg
Mn
Na
Ni
Pb
Sb
Se
Si
Sn
Sr
V
Zn

E = ORGANICS - CHEMICAL EXCEEDS LINEAR CALIBRATION RANGE
OF THE INSTRUMENT

E = INORGANIC - REPORTED VALUE IS ESTIMATED DUE TO
INTERFERENCE

F = ALPHA SPECTROMETRY - FWHM EXCEEDED ACCEPTANCE LIMITS

G = INORGANICS - NATIVE ANALYTE WAS REPORTED GREATER THAN
FOUR TIMES THE SPIKE ADDED CONCENTRATION

J = ORGANICS - POSITIVELY IDENTIFIED - RESULT
IS CONSIDERED TO BE ESTIMATED

J = INORGANICS & RADIONUCLIDES - ESTIMATED QUANTIFICATION

N = METALS - SPIKE RECOVERIES IN THE MATRIX SPIKE SAMPLE
DID NOT MEET ADVISORY LIMITS

S = METALS - THE REPORTED VALUE WAS DETERMINED BY
THE METHOD OF STANDARD ADDITION (MSA)

W = METALS - POST DIGESTION SPIKE DID NOT MEET CONTROL LIMITS

X = OPEN AND DEFINED BY LABORATORY (SEE SECTION 4 2 2 1 FOR
SPECIFIC APPLICATIONS)

Y = RADIONUCLIDES - CHEMICAL YIELD EXCEEDED ACCEPTANCE LIMITS

* = INDICATES THE RESULT IS AN AVERAGE OF THE REAL AND
DUPLICATE SAMPLE RESULTS

RADIONUCLIDES

Am-241
Cs-137
Pu-239
Pu-239/240
Ra-226
Ra-228
Sr-89 90
U-233-234
U-235
U-238

AMERICIUM-241
CESIUM-137
PLUTONIUM-239
PLUTONIUM-239/240
RADIUM-226
RADIUM-228
STRONTIUM-89 90
URANIUM-233 -234
URANIUM-235
URANIUM-238

VALIDATION CODES AND QUALIFIERS

A = RESULT ACCEPTED WITH QUALIFICATIONS
JA = RESULT ACCEPTED BUT WAS ESTIMATED
J = ESTIMATED RESULT DUE TO OUTSIDE HOLDING
TIME IMPROPERLY PRESERVED QUALITY CONTROL
PARAMETER OUTSIDE CONTROL LIMIT
V = VALID RESULT
VA = VALID RESULT WITH QUALIFICATIONS

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ANALYTE ABBREVIATIONS,
LABORATORY AND VALIDATION
QUALIFIERS